OPERATING INSTRUCTIONS

MODEL TTS 35B TRANSMISSION TEST SET

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MODEL TTS 35B TRANSMISSION TEST SET

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MODEL TTS-35B
TRANSMISSION
TEST SET
NORTHEAST ELECTRONICS
CORPORATION
CONCORD, N.H., U.S.A.
POWER
BATT
OFF
48V
T-BAT
S-GND
SL A
GND
SEND FREQ
1500
2000
2300
1300
2700
3000
1000
EXT
300
SEND LEVEL
.10
0
EXT FREQ
SEND ADJ
OFF
900n
600n
SND IMP & TERM A
ON
OFF
LINE A HOLD
SND A - REC B
TERM A AND REC B
REC A - SND B
2W
TERM
SND A
REC B
4W
LINE
FUNCTION
4 WIRE
2 WIRE (LA)
SND ADJ
4W AX ON A BX ON B
AX ON A
MEAS B
MEAS A AND B
4W
AX ON B
MEAS A
EXT CKT
OR
TEL SET
AC MON
INPUT
T
R
LINE A
A-2W-B
AX2W BX
SND-4W-REC
SND-4W-REC
LINE B
BATT. TEST
VU-DB
DBRN
BATT. TEST
HI PASS
3KC
15 KC
C MSG
FILTER
900n
600n
REC IMP & TERM B
ON
OFF
LINE B HOLD
SENS
BRDG
TERM
N-GND
SENS
DBRN-VU-DBM
SL B

FIG·1

MODEL TTS 35B TRANSMISSION TEST SET

OPERATING INSTRUCTIONS

1.0 GENERAL

1.01 The TTS 35B is a transistorized, self contained transmission test set designed to permit transmission tests over a wide variety of telephone circuits, such as local exchange or PBX circuits, as well as on 2-wire or 4-wire toll and program circuits. The test set contains an oscillator, a meter amplifier, hold coils, switchable filters, precision terminations, and switches used to select the different measuring functions.

1.02 Connections to the test set are made through standard telephone type (310) jacks centrally arranged along the lower edge of the front panel. The tip and ring of the LINE A and LINE B jacks are connected to binding posts and the sleeves to pin jacks to provide for external connections. The LINE A and LINE B jacks are spaced to permit insertion of a twin plug to facilitate testing of 4-wire systems. Two jacks, designated AX and BX, are provided to permit a parallel connection of a dial, external talk circuit, or any external circuit to the LINE A-B jacks.

1.03 The receive section is designed to measure a wide range of transmission levels, VU, and noise. A 4½" mirror scale meter, which includes red and green arcs for VU measurements, a VU-DB scale calibrated from +3 to -15 db, a dbrn scale calibrated from +13 to -5 dbrn, and a BATT TEST arc, is centrally located on the panel.

1.04 The set has a sensitivity of -80 dbm and 0 dbrn at 0 db and 0 dbrn on the meter scale respectively. The sensitivity of the set can be varied from -80 dbm to +20 dbm and from 0 to 100 dbrn in 1 db and 10 db steps by means of two attenuators. For identification the db steps are in white, the dbrn are in blue.

1.05 Switchable filter networks, designated 15 KC, 3 KC, and high pass are provided internally, to either attenuate the low frequency band around 60 cycles and its harmonics, or to attenuate frequencies above the voice band. A filter which provides C-message weighting is also included. For the response curves of the individual filters see Figures 16 and 17.

1.06 The input to the receiver is through a balanced transformer with DC blocking capable of withstanding 150 volts DC of either polarity. Circuits of 600 or 900 ohms, balanced or unbalanced, can be measured in either a terminated or bridging condition. Noise to ground can be measured with a 40 db loss; a longitudinal drain is supplied.

1.07 A monitor jack provides an AC output which may be used to drive external circuits such as an impulse noise measuring set and a telephone headset to determine the nature of the signal, thereby using the TTS 35B as a variable, high gain amplifier.

1.08 The oscillator section can send individual tone frequencies of 300, 1000, 1300, 1500, 2000, 2300, 2700, and 3000 cycles, selected by the SEND FREQ switch. An additional position marked EXT FREQ on the SEND FREQ switch can be used to transfer the frequency determining circuits in the oscillator to a front panel connector socket marked EXT FREQ. This permits connection of an accessory panel which is contained in a special removable cover, to provide continuous tuning for the oscillator from 200 to 7000 cycles (Model TTS 35XV).

1.09 A SEND ADJ control is provided to adjust the oscillator output level from 0 dbm down to -30 dbm, and the SEND ADJ position of the FUNCTION switch provides an internal connection from the oscillator to the level meter. This permits setting up any desired send level. In addition, a fixed -10 db pad can be inserted or removed from the oscillator output.

1.10 The maximum level variation when switching the SEND frequencies is ±0.2 db. This permits changing frequencies without requiring a readjustment in the oscillator output level for each frequency change.

1.11 The oscillator output is connected to the line through a DC blocked transformer. A SEND IMP switch permits the selection of either a 600 or 900 ohm output impedance.

1.12 The switching functions of the test set are controlled by three switches, the LINE switch, the FUNCTION switch, and the EXT CKT or TEL SET switch. The FUNCTION switch has three positions and is used to select one of the following: 2-wire operation, 4-wire operation or, in the SND ADJ position, allows for the setting of the send level using the meter amplifier as reference. The purpose of the LINE switch and the EXT CKT or TEL SET switch will be explained in the following paragraphs.

1.13 For 2-wire circuits access to the oscillator and receiver can be made through either the LINE A or LINE B jack, depending upon the position of the LINE switch. It is also possible to simultaneously send and receive on either the LINE A or LINE B jack. By use of the EXT CKT or TEL SET switch, regardless of the position of the LINE switch, the AX jack can be connected to either the LINE A or LINE B jack for the purpose of dialing and monitoring.

1.14 When the LINE switch is in the TERM A and B position, terminations of 600 or 900 ohms +2 mfd are connected to the LINE A and LINE B jacks. The termination on LINE A is controlled by the SEND IMP & TERM A switch, and the termination on LINE B is controlled by the REC IMP & TERM B switch.

1.15 For 4-wire circuits the LINE switch selects either SND A or REC B. The LINE A jack being used for the send leg and the

LINE B jack being used for the receive leg. The TERM position of the LINE switch performs the same function on 4-wire operation as on 2-wire.

1.16 The termination on the LINE A jack serves a special function in 4-wire operation. The purpose is as follows. Assume that a 4-wire circuit is terminated at the far end by a 4-wire termination set and a test signal is applied to the 2-wire side of this termination set. To measure the transmission loss from the 2-wire far end circuit to the 4-wire near end receive leg it is necessary to make sure no signals are applied to the near end 4-wire send leg. If signals should be applied to the near end send leg, part of their energy will be transmitted through the far end hybrid and will add to the far end signal, giving an erroneous loss measurement. The only occasion when this does not occur is when a perfect hybrid balance exists at the far end. To prevent this, when the LINE switch is in the REC B position, 600 or 900 ohms +2 mfd is applied to the near end send leg connected to LINE A.

1.17 The EXT CKT or TEL SET switch, when in the AX ON A and BX ON B position, connects the AX jack to the LINE A jack and the BX jack to the LINE B jack.

1.18 Switchable hold coils are provided on the LINE A and LINE B jacks.

1.19 The TTS 35B is powered by either internal batteries or from an external 48 volt supply. A BATT TEST push button is provided to monitor the condition of the internal batteries and to determine that the external 48 volts is properly connected. A diode is provided to protect the internal circuits in the event the wrong polarity of 48 volts is applied.

1.20 The POWER switch is used to select either the internal batteries or external 48 volts and controls the power for the entire unit. A separate ON-OFF switch for the oscillator is provided to permit turning the oscillator off when not in use.

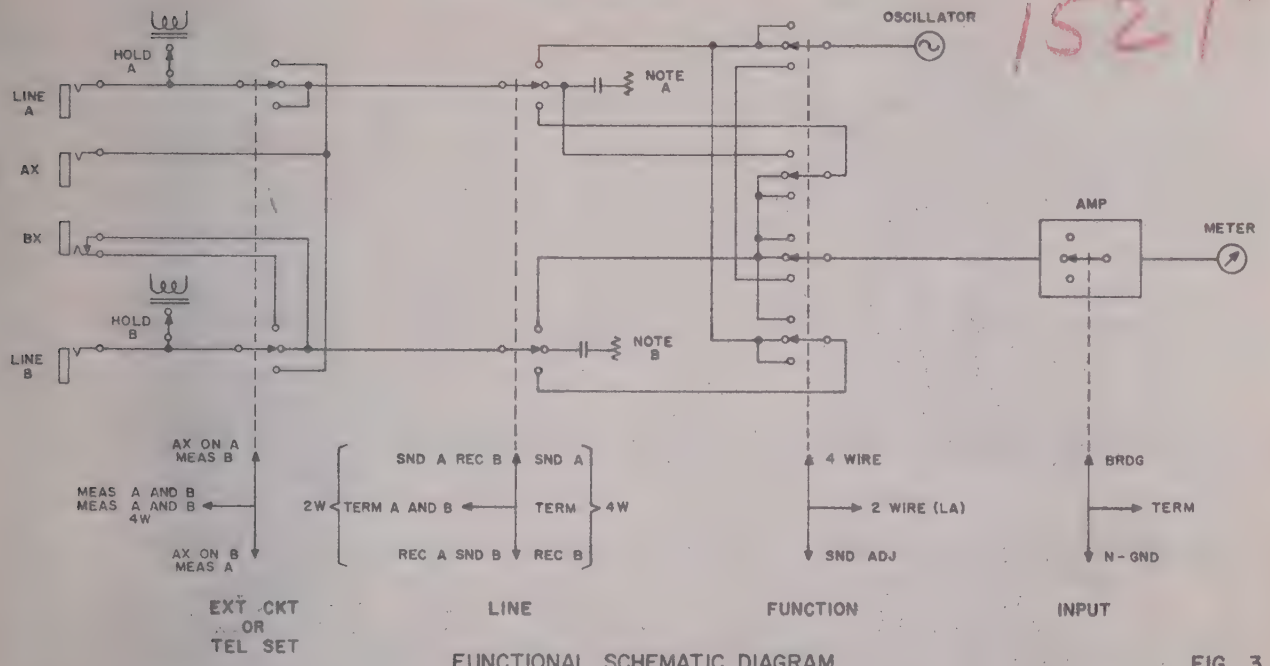
1.21 Twelve 1.5 volt D cells are required for internal batteries. The batteries are accessible from the rear of the unit by removing a back cover.

1.22 The TTS 35B is contained in a gray finished aluminum case 14" w x 10 7/8" h x 8" d. The weight of the unit is 19½ pounds. Storage for cords is provided in the removable hinged cover. Closing the cover will move the POWER switch to the OFF position.

1.23 The front panel view of the TTS 35B is shown in Figure 1. The overall block diagram is shown in Figure 3.

NOTE FOR Serial NO 1521

NOTE A – TERM ON LINE A HAS SAME VALUE AS SEND IMP SELECTED
NOTE B – TERM ON LINE B HAS SAME VALUE AS REC IMP SELECTED



FUNCTIONAL SCHEMATIC DIAGRAM FIG. 3

SPECIFICATIONS

RECEIVE SECTION

METER CALIBRATION

Level Measurements: +3 dB to −15 dB.
Noise Measurements: +13 dBrn to −5 dBrn.
Scale: 0.2 dB divisions from +3 dB to −3 dB and +13 dBrn to +7 dBrn.
0.5 dB divisions from −3 dB to −10 dB and 0 dBrn to +7 dBrn.
1.0 dB divisions from −10 dB to −15 dB and 0 dBrn to −5 dBrn.
Tracking Accuracy: ±0.15 dB +3 dB to −3 dB.
The dBrn scale is printed in blue.
For VU measurements colored arcs are provided as follows:
between +3 dB and 0 dB — Green
0 dB and −6 dB — Yellow
−6 dB and −15 dB — Red
For battery test a green arc marked GOOD is provided.

RANGE OF MEASUREMENTS

a. Level Measurements: +23 dBm to −95 dBm.
b. Noise Measurements: +113 dBrn to −5 dBrn.
c. Noise to Ground Measurements: +113 dBrn to −5 dBrn on meter. (Actual noise to ground 40 dB higher than measured value.)

MONITOR OUTPUT

a. Output Impedance: 600 ohms.
b. Output Level: −10 dBm, ±1.0 dB when meter reads 0 dBrn.
c. Maximum Output: +2.0 dBm.

INPUT IMPEDANCES

Balanced input transformer.
a. Terminated: 600 or 900 ohms ±5% with a phase angle of less than 5° when hold coil is out.
b. Bridging: approximately 15,000 ohms.
c. Longitudinal drain: Across the line — 85,000 ohms.
to ground — 100,000 ohms.

FREQUENCY RESPONSE

The frequency response of the receive section is determined by switch selection of one of the following filters.
C Message: Normalized for zero insertion loss at 1 kHz
High Pass: ±1 dB 300 Hz to 5 kHz
Attenuation 3 dB nominal at 200 Hz and 12 kHz
25 dB at 60 Hz, 4 dB at 180 Hz
3 KC: ±.2 dB 600 Hz to 2 kHz
Attenuation 3 dB nominal at 3 kHz
HF cutoff characteristic 18 dB per octave
15 KC: ±.2 dB 100 Hz to 5 kHz
Attenuation 3 dB nominal at 15 kHz
HF cutoff characteristic 18 dB per octave

The reference frequency for filter specifications is 1 kHz. A typical frequency response curve for each filter is shown in Figures 1 and 2. Other filter characteristics are available on special order.

ACCURACY

Overall measurement error at 1 kHz at ordinary room temperature and with good batteries will not exceed ±0.2 dB.
Attenuator Accuracy: ±0.1 dB.
Temperature Error: ±0.15 dB maximum at 1 kHz for temperatures from 30°F to 120°F, with respect to readings taken at 72°F.
Battery Voltage Error: ±0.1 dB maximum for battery voltage reading within the green BATT TEST arc on the meter scale.

SEND SECTION

Frequencies: Eight frequencies selected by a switch: 400, 1000, 1300, 1500, 2000, 2300, 2800, and 3000 Hz + EXT.
Two additional frequencies can be supplied.
Frequency Accuracy: 2% from 50°F to 100°F.
Distortion: Less than 1% at any harmonic.
Output Level: Can be set by means of the SEND ADJ control and calibrated from any level from +3 to −40 dBm.
The maximum level variation when switching frequencies is ±0.2 dB.
Output Impedance: 600 ohms or 900 ohms selected by switch.
Line Jacks: Switchable hold coil and DC blocking provided.

MISCELLANEOUS

Power Requirements:
a. Battery Operation: Requires twelve 1.5 volt D cells which are accessible from the bottom of the unit.
b. Battery Life: Intermittent use approximately 130 hours.
c. 48 Volt Operation: Requires 48 volt central office battery, current drain 84 ma.

SIZE

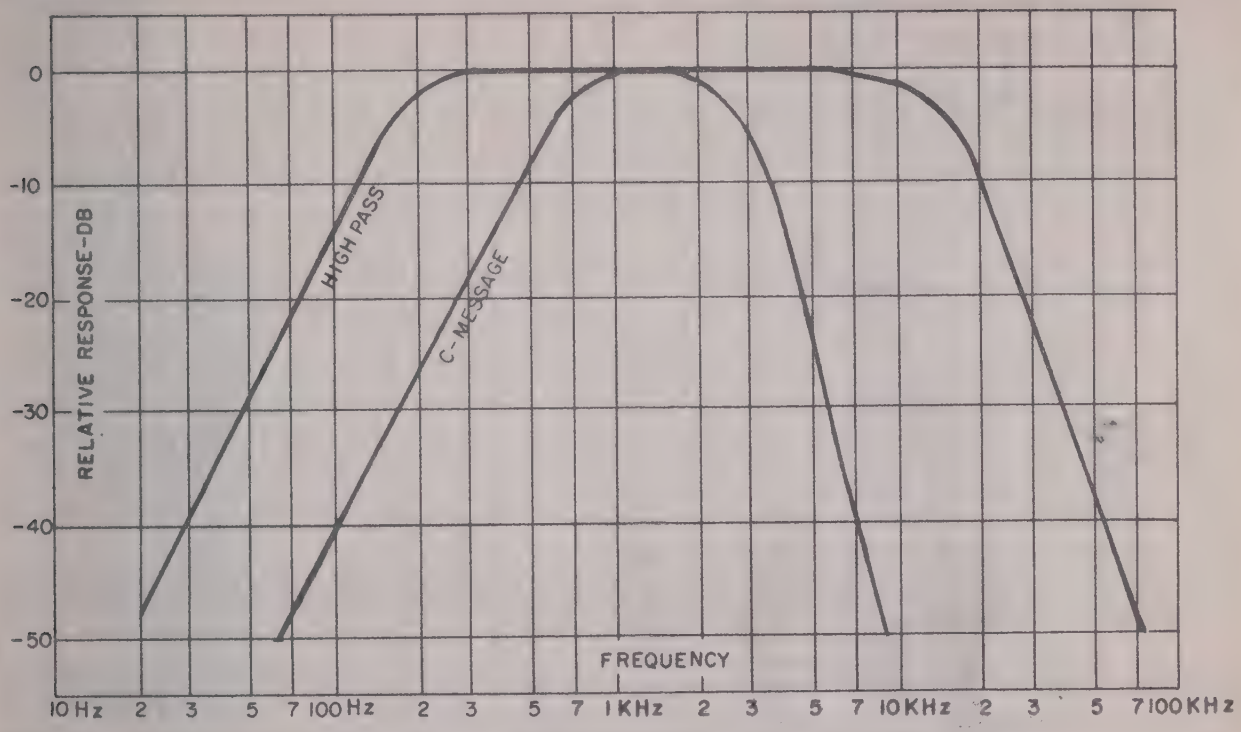
Model TTS 35B: 14" w x 8¾" h x 8" d.
Model TTS 35BR: 8¾" x 19" (23" adapters available on request).

WEIGHT

19½ pounds.

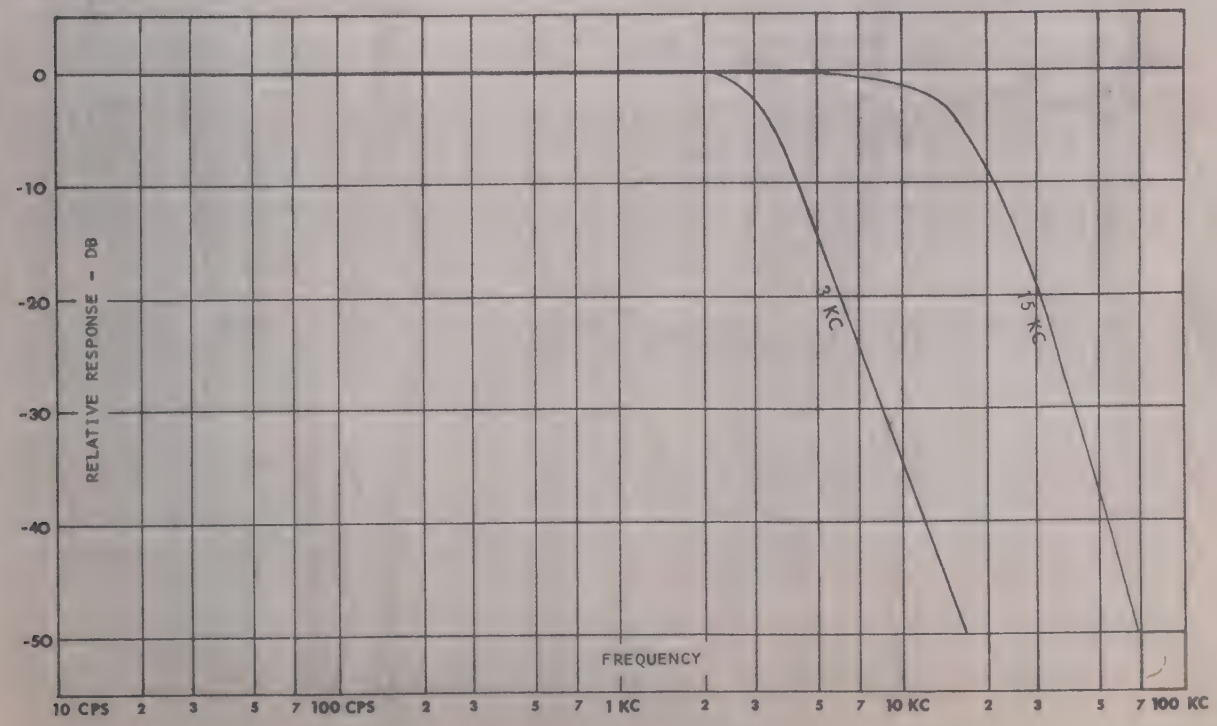
FREQUENCY RESPONSE
with
C - MESSAGE AND HIGH PASS FILTERS

Fig. 1



FREQUENCY RESPONSE
with
3 KC and 15 KC FILTERS

Fig. 2



The Model TTS 35B is a portable, transistorized, self-contained transmission test set designed to perform transmission tests, noise, and VU measurements over a wide range of telephone circuits, from local exchange loops to 4-wire toll and special service circuits. The set features an oscillator, meter circuit, filters, precision terminations, hold coils, and unique switching circuitry to conveniently select the various combinations of features. Figure 3 is a functional schematic diagram of the switching.

The receive section has a sensitivity of −80 dBm at 0 dB on the meter which has a scale calibrated to −15 dB, thus providing a measurement range to −95 dBm. The meter is also calibrated in dBrn, thereby permitting noise measurements to −5 dBrn. 1 dB and 10 dB step attenuators provide a range of sensitivity control of 100 dB.

The send section provides for the transmitting of 8 fixed frequencies of 400, 1000, 1300, 1500, 2000, 2300, 2800, and 3000 Hz individually selected by a switch. The output level of the oscillator is adjustable from +3 dBm to −40 dBm.

The unit operates from internal batteries or 48 volt DC central office battery.

A rack mounted model designated Model TTS 35BR is also available.

RECEIVE SECTION

A. Input Circuit

The input line connections are made to a balanced transformer with DC blocking capable of withstanding 150 volts DC of either polarity. Terminating resistors for 600 and 900 ohm input impedances can be switched directly across the input line while maintaining the DC blocking. These resistors are switched in a balanced circuit to maintain a balance of 60 dB at 1000 Hz. The hold coil, which can be switched across the line, is switched at the center tap for the same reason. When the input is used as a bridging impedance, the terminating resistors are removed and the input impedance of the transformer is approximately 15,000 ohms. The bridging loss without hold coil is approximately 0.2 dB for frequencies above approximately 50 Hz.

B. Attenuators

Two step attenuators are provided. One covers a range of 90 dB in 10 dB steps and the other covers 10 dB in 1 dB steps. 1% resistors are used to assure an accuracy better than ±0.1 dB. Both attenuators are calibrated in DBM and DBRN. The DBM calibration is shown in black numbers; blue numbers are used for the DBRN calibration to simplify identification and correlation with the blue DBRN scale on the meter.

C. Filters

The frequency response of the Model TTS 35B may be adjusted with a FILTER switch to provide four different response curves as shown in Figures 1 and 2.

The C Message filter provides the characteristics normally used for noise measurements.

The high pass filter provides rejection of 60 Hz and its lower harmonics and is useful when testing circuits which have power line hum pickup.

The 3 KC filter position has a response which falls off above 3 KC at the rate of 18 dB per octave.

The 15 KC filter position has a response which falls off above 15 KC at the rate of 18 dB per octave.

Other filters are available on request.

D. Meter Circuit

A rugged 4½″ precision meter is provided. It is used for measuring levels and provides a battery test when the BATT TEST switch is depressed. There are two scales, one calibrated from +3 dB to −15 dB and marked in black, and the other calibrated from +13 dBrn to −5 dBrn and marked in blue.

SEND SECTION

A stable oscillator and a SEND ADJ control provide for a continuously variable level from +3 dBm to −30 dBm through an output transformer which is balanced to ground and provides either 600 or 900 ohms impedance. A switchable 10 dB pad is included.

A SEND FREQ switch permits selection of any one of the frequencies of 400, 1000, 1300, 1500, 2000, 2300, 2800, and 3000 Hz. Two additional fixed frequencies may be added on an optional basis.

A connector socket designated EXT FREQ is provided to connect an optional frequency determining network Model TTS 35XV in an accessory cover to the oscillator to provide for continuous tuning from 200 to 7000 Hz.

A switchable hold coil is also provided on the output to maintain an off hook condition.

MISCELLANEOUS

A. Monitoring

The AC MONITOR jack provides means for listening to the signal being tested, to drive an impulse noise measuring set, or to drive external circuits, thereby using the TTS 35B as a high gain amplifier. A portion of the AC output of the last amplifier is applied to an isolating monitor amplifier which supplies the output to the AC MONITOR jack; consequently, monitoring the signal will have no effect on the measurements made on the TTS 35B meter. DC blocking is provided at the AC MONITOR jack. The AC monitor output level is −10 dBm when the meter reads 0 dB; the maximum undistorted output is −2.0 dBm.

B. Dial and Talk

An external dial or talk circuit may be connected to the AX2W jack and switched to either the LINE A or B jacks. Circuits may be dialed over either of the LINE jacks and held by the LINE A or LINE B HOLD switches.

C. Precision Terminations

Precision terminations of 600 or 900 ohms may be switched by the SND IMP & TERM A and REC IMP & TERM B keys to either of the circuits connected to the LINE A and B jacks.

For 4-wire operation the send leg connected to the LINE A jack is terminated while measuring on the receive leg connected to the LINE B jack.

D. 2-Wire and 4-Wire Operation

The LINE and FUNCTION key switches positioning permits the oscillator or meter to be switched to either the LINE A or B jack. The oscillator and meter circuits may also be switched to both the LINE A and B jacks at the same time and then reversed for use with loop around tests.

For 4-wire operation both the send and receive leg of the circuits under test are connected to the LINE A and B jacks respectively. The positioning of the FUNCTION switch to 4-wire switches control of the send and receive function to the LINE switch so that the oscillator may be connected to the LINE A jack or the meter connected to the LINE B jack, at which time the LINE A jack is terminated.

E. Calibration

No external calibration control has been provided as the set is extremely stable and will hold its calibration for a long period of time. An internal adjustment is provided if routine checks indicate a need for recalibration.

F. Power

The set may be operated from internal batteries or from 48 volt office battery. A voltage regulator is used to maintain a constant voltage to the circuits in the set when it is used on the 48 volt office battery. An optional accessory designated Model TTS 35XPS can be added in the lid to provide for operation on 115 VAC power.

G. Mechanical

The TTS 35B is contained in a 14″ w x 8¾″ h x 8″ d gray finished aluminum carrying case and weighs 19½ pounds. Storage for cords is provided in a hinged removable cover.

The TTS 35BR (rack mounted) occupies 8¾″ of vertical space in a standard 19″ relay rack. Adapters for 23″ relay racks are available on request.

H. Accessories

The following accessories are available in various combinations for the TTS 35B in the cover, and as additional panels for the TTS 35BR:

Model TTS 35XD — Dial Adapter
Model TTS 35XDT — Dial and Talk Adapter
Model TTS 35XV — Continuously Variable Frequency Adapter (200 Hz to 7 kHz)
Model TTS 35XPS — AC Power Supply Adapter

d. AC Monitor Output:

Output Impedance: 600 ohms
Output Level: -10 dbm when meter reads 0 db

e. Attenuator Accuracy: ±0.1 db

f. Stability of Calibration:

Temperature Errors: Typical performance at 0 db on meter 35°F to 110°F -- ±0.1 db change from 70°F

Supply Voltage Errors: Typical performance at 0 db on meter ±.01 db change from 18 volts to 12 volts

Meter

a. A 4½" meter with a mirror scale and the following markings is provided:

VU-DB scale in black divisions and numbers:

0.2 db divisions from +3 db to -3 db
0.5 db divisions from -3 db to -10 db
1 db divisions from -10 db to -15 db

DBRN scale in black divisions and blue numbers:

0.2 db divisions from +7 to +13
0.5 db divisions from +7 to 0
1.0 db divisions from 0 to -5

VU arc in three colors:

Green between 0 and +3
Yellow between 0 and -6
Red between -6 and -15

BATT TEST arc in green marked GOOD

b. Meter Accuracy: ±.15 db at 1 KC from +3 to -3 on meter.

2.02 Oscillator Section

a. Frequencies:

Eight fixed frequencies selected by a switch - 300, 1000, 1300, 1500, 2000, 2300, 2700, and 3000 cps

The EXT position provides for connecting an external frequency determining network, such as the TTS 35XV.

b. Frequency Accuracy

Fixed Frequencies: ±2% from 50°F to 100°F
Variable Frequencies: ±3% from 50°F to 100°F

c. Level Variation with Frequency

Fixed Frequencies: ±0.2 db
Variable Frequencies: ±0.3 db

d. Distortion: less than 1% at any harmonic

e. Output Level: Can be set by means of the SEND LEVEL control and calibrated for any level between 0 db and -30 db. A -10 db pad can be switched in or out.

f. Output Impedance: The SEND impedance can be switched to 600 or 900 ohms. At 1000 cps these impedance values are within ±5% of nominal impedance.

2.03 Power Requirements

a. Battery Operation (12 1.5 volt D type cells)

Receive Section: 18 ma (without AC monitor) 28 ma AC monitor on

Oscillator Section: 16 ma

Battery Life: Approximately 130 hours intermittent use

48 Volt Operation: Requires 48 volt office battery
Current drain 84 ma.

3.0 CIRCUIT DESCRIPTION

3.01 Receive Section

The gain of the set is obtained from 3 amplifiers. Each amplifier is enclosed with a large amount of negative feedback to insure gain stability. The inherent noise level of the unit is at least -100 dbm and approaches -120 dbm when the C message filter is used. The circuits can be divided into the following basic elements.

A. Input Circuit
B. 10 db Step Attenuator
C. Amplifier 1
D. Filter Switching Network
E. 1 db Step Attenuator
F. Amplifier 2
G. Amplifier 3
H. Metering Circuit
I. Monitoring Circuit
J. Power Section

A. Input Circuit (Figure 4)

The input line connections are made to a balanced transformer with DC blocking capable of withstanding 150 volts DC of either polarity. Terminating resistors for 600 and 900 ohm input impedances can be switched directly across the input line and the DC blocking is still maintained. These resistors are switched at the equal potential or center tapped point to maintain balance. The input circuit is balanced at least 80 db at 60 cps, 70 db at 1000 cps, and better than 60 db up to 10 KC. A longitudinal drain, whose center tap is connected to ground through a resistor, is supplied. The transformer has a 1:1 ratio. Since the secondary of this is loaded by a high impedance, the primary of the transformer also looks like a high impedance. This reflected impedance is seen in the bridging positions of the INPUT switch. It is nominally 12,000 ohms for 600 ohm circuits and 15,000 ohms for 900 ohm circuits. The bridging losses will be less than ±0.2 db for frequencies down to approximately 100 cycles.

B. 10 db Step Attenuator (Figure 5)

This is a three section attenuator which is the main sensitivity adjustment of the set. 30 db is available in one section and is merely a tapped voltage divider. Two other sections, each having 30 db loss, can be switched ahead of this. For the first 30 db of loss the tapped voltage divider only is used. For 40 db of loss, which corresponds to the -30 db position of the SENS control, a single 30 db section is placed ahead of the step voltage divider, and 10 db of loss is brought into the output section. Thus, the stepped divider is used for the 10 db steps, and the other two sections are brought in as necessary to extend the range of these 10 db

steps. 1% resistors are used, which assures an attenuator accuracy of ±0.10 db.

C. Amplifier 1 (Figure 6)

Amplifier 1 is basically a two stage voltage amplifier with negative feedback. An emitter follower is incorporated in the output stage since this amplifier drives the filter sections.

Q102, Q103, and Q104 comprise the amplifying section. Q102 is a conventional common emitter whose bias is obtained from the collector for DC stabilization. Q103 is also operated in the common emitter, but since this is also an NPN, bias conditions and polarities are reversed. Q104 operates as a common collector or emitter follower to isolate the filter impedances from the collector of Q103 to which it is DC connected. The emitter current of Q104, both AC and DC, is eventually returned to a resistor which is common to the emitter of Q102; this comprises negative feedback. For the circuit shown approximately 30 db of feedback is achieved and is effective over the entire band of frequencies. The two diodes in the emitter of Q104 are a battery compensating network. If the battery voltage decreases, the emitter current of Q104 will also decrease. This raises the impedance of these two diodes, which decreases the negative feedback by a slight amount, thereby keeping the overall gain of the set relatively independent of the battery voltage. The emitter of Q104 supplies an output through an RC network which keeps DC and voltage transients producing by switching from subsequent stages. The nominal output impedance of the amplifier is in the order of 5 ohms, due to its emitter follow type output and heavy amounts of feedback. A series resistance is used to bring this up to a value to match the filter characteristics, which is basically 600 ohms.

D. Filter Switching Network (Figure 7)

This selects the proper components to produce the responses shown in Figures 16 and 17.

E. 1 db Step Attenuator (Figure 8)

This is a conventional stepped voltage divider which presents a 600 ohm impedance to the filter and is terminated by the high impedance of Amplifier 2. 1% resistors are used, which assures an accuracy of ±0.10 db.

F. Amplifier 2 (Figure 9)

This is a three stage amplifier incorporating negative feedback consisting of Q201, Q202, and Q203. Overall feedback is applied from the emitter of Q203 to the emitter of Q201, while the output is taken from the collector of Q203. Q201 is a conventional common emitter amplifier with collector to base bias. Q202

is also a common emitter configuration, but since this is an NPN, the emitter is returned to battery while the collector is returned to ground. The output of Q202 which appears at its collector is direct coupled to the base of Q203. This is also of the common emitter configuration. The emitter of Q203 contains a large amount of DC resistance to give the proper amount of current when its base is connected to the collector of Q202. Most of this resistance is bypassed by C203 so that degenerations at signal frequencies will not occur at this point. The unbypassed part of the emitter resistance is R209, which is common to the emitter of Q201. This provides overall loop feedback which stabilizes the gain of the entire amplifier.

G. Amplifier 3 (Figure 10)

Amplifier 3 consists of Q301 and Q302. Both are operated as common emitters with bias derived from the collector for DC stabilization. The output of Q302 is applied to the diode bridge, which is returned to the emitter of Q301, and thus supplies negative feedback. The operation of such a network can be best described on a half cycle basis. When the signal at the collector of Q302 is a negative half cycle, CR302 will not conduct due to its polarity connection. CR301 will conduct. The signal, however, cannot go through CR303. It can go through the meter and through CR304 back to the emitter of Q301. Note that wave current is from right to left through the meter.

When the collector of Q302 goes positive, similar reasoning will show that the path of conduction will be through CR302, the meter, CR303 back to the emitter of Q301. Note that on this half cycle the meter also conducts from right to left. Thus the meter has a pulsating of full wave type current. The ballistics of the meter will ignore the peaks and respond to the average value of DC. The meter is calibrated so that this average value reads in RMS value. The characteristics of such a circuit linearize the resistances of the diodes. For instance, as the resistance of the diodes increases, either due to temperature changes or to decreased meter current, the feedback is automatically adjusted so that the meter current is a linear function of the input voltage. This is true for wide ranges of temperature and also true for greatly mismatched diodes, thus the circuit is relatively uncritical either to component values or diode voltage current relationships.

The use of the diode bridge in the feedback loop produces two results. The bridge is loading the output of Q302; since it is a non-linear bridge, it can be expected that the waveform at Q302 will be distorted. This is true, and the waveshape appears as a flattened sine wave with very sharp edges around the center of the curve. The edges are produced by the fact that for a fraction of a volt on either side of zero the diodes are not conducting and unload the collector circuit. The flattening is a result of the fact that the diode resistance goes down as the voltage goes up.

It therefore tends to flatten out the peaks of the sine wave. The feedback mechanism produces a linear current through the diodes. The two half cycles of current are recombined at the emitter of Q301 to form a perfect sine wave.

H. Metering Circuit (Figures 10 and 11)

The meter is used for two functions. One is to measure the level applied to the line terminals of the set and under this condition it is applied to the diode bridge of Amplifier 3. It is also used for battery test, at which time it is disconnected from Amplifier 3 and connected between battery and ground through a dropping resistance which converts the milliamp meter into a voltmeter to monitor the condition of the battery.

I. Monitoring Circuit (Figure 10)

The AC monitor consists of Q303, which samples part of the signal available in Amplifier 3, amplifies it, and provides a given source of impedance available to the AC MON jack. The signal which this amplifier samples is at the emitter of Q301 in Amplifier 3. This is a low impedance point, a sine wave, and is still a direct function of the signal appearing at the LINE jack. The input impedance of the monitor amplifier, Q303, is high enough so that it does not shunt the emitter resistance of Q301, and therefore it does not materially influence the amount of feedback or the value of the gain of either Amplifier 3 or the entire set. To conserve internal battery power the collector supply of Q301 is normally cut off until the plug is inserted into the AC MON jack. The signal available at the AC MON jack is DC blocked so that a DC resistance can be inserted between the tip and ground of the jack. This DC blocking is done by an electrolytic which means that if any DC voltage should be applied to the tip of the AC MON jack, it should not exceed 9 volts negative or 12 volts positive.

The frequency response of the monitoring circuit is -3 db at 100 cycles and 15 KC for the flat 15 KC position. For other filter positions the response at the monitor jack is identical with the response to the meter. Signal to noise output at this jack will always be better than 30 db for meter readings of at least -3 dbm. The output level is -10 dbm when the meter reads 0 dbm.

J. Power Section (Figure 11)

For an amplifier with this much gain and with such a low frequency response, it is necessary to insure that there is no impedance in common with the amplifier supply. Since certain areas of these amplifiers have bandwidths which extend down to 1 cycle, ordinary RC coupling is inadequate except with extremely large values of capacitance. The decoupling in this set may appear slightly unconventional in that Amplifier 1 and Amplifier 2 are

decoupled from the battery supply by a transistor, Q1. Essentially this transistor is operated as a series device although, strictly speaking, it can be considered as an emitter follower. It operates with sufficient base bias to insure saturation and very little collector to emitter voltage drop, and with a capacitor, C2, from base to ground. The base is held relatively fixed by this capacitance and the emitter must follow the base. The effect of such a circuit is the same as a conventional RC decoupling network except that the RC product is effectively increased by the beta of the transistor. In other words, we get the same amount of decoupling with 100 mfd as we would with 5000 mfd in conventional RC decoupling.

Amplifier 3 is supplied through a conventional RC decoupling, the chief function of which is to keep the battery impedance relatively constant and insure that no local feedback introduced by an aging battery will seriously affect the low frequency response.

When a plug with 48 volts of the proper polarity is inserted in the 48 volt jack, CR1 will conduct and CR2, a zener diode, will conduct in the reverse direction and maintain a constant voltage. R10 limits the amount of current through the zener diode to a proper value. The use of the zener and the series transistor filter produces sufficient filtering so that the proper signal to noise will be obtained, provided the noise on the station battery does not exceed 1 volt peak to peak at 10 cycles or higher.

The battery test resistor is connected to the meter from the zener diode. This is the primary point of power application whether it is from internal or external batteries. Notice that the reading of the battery test can only occur when the power switch is on and thus represents a load on the batteries.

3.02 Oscillator Section

The oscillator section can be divided into the following basic elements:

A. Oscillator
B. Buffer Amplifier and Output Circuit
C. Power Section

A. Oscillator (Figure 12)

The bridged-T oscillator uses three PNP transistor stages. The first two, Q101, and Q102, are directly coupled from the collector of Q101 to the base of Q202. The positive feedback path is from the emitter of Q102 back through LP101, a tungsten bulb used for level stabilization, to the emitter of Q101. The emitter resistor, P102 of Q101, is adjustable to permit factory setting of the correct amount of positive feedback necessary for stable operation. A negative feedback which is normally greater than the positive feedback is supplied to the base of Q101 through a null selective

network and an emitter follower, Q103. The selective bridged-T null network decreases the negative feedback sufficiently to permit oscillation to occur at the selected frequency, which is determined by the values in the bridged-T circuit. For the fixed frequencies the frequency determining network consists of capacitors C152 and C153 and two resistors selected by the SEND FREQ switch. For the variable frequencies the network consists of capacitor C152 and C153 and the network shown in Figure 18.

B. Buffer Amplifier and Output Circuit

The buffer amplifier uses two PNP transistors stages, Q104 being an amplifier and Q105 an emitter follower for impedance matching. The oscillator voltage obtained at the emitter of Q102 is connected to the base of Q104 through the level control, P101. This control is located on the front panel and permits setting the output level from 0 db to -30 db. The output is taken from the emitter of Q105 and coupled to the primary of the output transformer, T2, through C160. The secondary of T2 is DC blocked and can withstand 75 volts DC of either polarity. The SEND LEVEL switch inserts or removes a fixed -10 db pad into the oscillator output. The SEND IMP switch selects the proper resistive values for an output impedance of 600 or 900 ohms. In addition it also selects the proper values for the -10 db pad, depending upon the output impedance desired.

C. Power Section (Figure 11)

The oscillator-buffer is decoupled from the common battery circuit to eliminate feedback between the oscillator section and receive section. The decoupling section consists of R159, a 47 ohm resistor, and C158, a 100 mfd capacitor. Normal operation of the oscillator-buffer requires 18 volts. Therefore, to utilize power from a 48 volt source the voltage divider shown in Figure 11 is used. The input to the voltage divider is diode protected to prevent damage in the event the wrong polarity is applied.

4.0 CONTROLS, SWITCHES, JACKS, TERMINALS

4.01 The following controls and switches are provided.

S1 - LINE A HOLD switch - ON-OFF switch for the hold coil on the LINE A jack.

S2 - LINE B HOLD switch - ON-OFF switch for the hold coil on the LINE B jack.

S3 - LINE switch - A 3-position key switch which performs the following functions.

a. For 2-wire circuits:

SEND A-REC B: Connects the oscillator output to the LINE A jack and the input to the receiver to the LINE B jack.

TERM A-B: Connects a termination of 600 ohms +2 mfd or 900 ohms +2 mfd, depending upon the position of S6 and S16, to the LINE A and LINE B jacks.

REC A-SEND B: Connects the input of the receiver to the LINE A jack and the output of the oscillator to the LINE B jack.

b. For 4-wire circuits:

SND A: Connects the output of the oscillator to the LINE A jack and terminates the LINE B jack in the receiver.

TERM: Connects a 600 ohm +2 mfd or 900 ohm +2 mfd termination, depending on the position of S6 and S16, to the LINE A and LINE B jacks.

REC B: Connects the input of the receiver to the LINE B jack and terminates the LINE A jack with a 600 ohm +2 mfd or 900 ohm +2mfd termination, depending on the position of S16.

S4 - FUNCTION switch - A 3-position key switch used to select the following mode of operation:

a. 4-wire operation

b. 2-wire operation

c. SND ADJ: Connects the output of the oscillator to the input of the receiver to allow setting up the desired output level.

S5 - EXT CKT or TEL SET - A 3-position key switch which performs the following functions:

a. For 2-wire circuits:

AX ON A-MEAS B: Connects the LINE A jack to the AX jack to allow connection of an external dial or tel set to LINE A. Allows measurements to be made on the LINE B jack as selected by the S3 LINE switch.

MEAS A AND B: In this position the LINE A and B jacks are controlled by the S3 LINE switch.

AX ON B-MEAS A: Connects the LINE B jack to the AX jack to allow connection of an external dial or tel set to LINE B. Allows measurements to be made on the LINE A jack as selected by the S3 LINE switch.

b. 4-wire circuits:

4W AX ON A-BX ON B: Connects the AX jack to the LINE A jack and the BX jack to the LINE B jack to allow connecting an external dial or tel set to the LINE jacks.

MEAS A AND B 4W - In this position the LINE A and B jacks are controlled by the S3 LINE switch.

S6 - REC IMP AND TERM B - Selects either a 600 or 900 ohm impedance for the receiver input and selects either a 600 or 900 ohm +2 mfd termination for the LINE B jack.

S7 - INPUT switch - For selection of the following receive functions: BRIDGING, TERMINATED, or NOISE TO GND measurements.

S8 - SENS 10 DB switch - A 10-position rotary switch with levels from +20 to -70 dbm and 90 to 0 dbrn in 10 db steps (dbrn markings in blue).

S9 - FILTER switch - For selection of one of the following filter networks: HIGH PASS, CMSG, 3 KC, 15 KC.

S10 - SENS 1 DB switch - A 10-position rotary switch with levels from 0 to -10 dbm and 10 to 0 dbrn in 1 db steps (dbrn markings in blue).

S11 - BATT TEST push button - Used to monitor the condition of the internal batteries.

S12 - POWER switch - Used to select either internal batteries or external 48 volts.

S13 - SEND ADJ OFF switch - This switch is part of the SEND ADJ control and permits the oscillator to be turned off and the receive section to remain on.

S14 - SEND FREQ switch - Selects one of the eight fixed frequencies or connects the oscillator to the EXT FREQ connector to allow the use of external frequency determining networks.

S15 - SEND LEVEL switch - When set to the -10 db position switches in a fixed -10 db pad in the oscillator output.

S16 - SEND IMP & TERM A - Selects either a 600 or 900 ohm output impedance for the oscillator and selects either a 600 or 900 ohm +2 mfd termination for the LINE A Jack.

P101 - SEND ADJ control - Used to set the oscillator output to the desired level.

4.02 The following jacks and terminals are provided.

J1 - A 310 jack for LINE A 2W and 4W SND.

J2 - A 310 jack for LINE B 2W and 4W REC.

J3 - A 310 jack for 2W EXT CKT or TEL SET and 4W SND-EXT CKT or TEL SET.

J4 - A 310 jack for 4W REC-EXT CKT or TEL SET.

J5 - A 310 jack for connecting the external 48 volt supply.

J6 - A 310 jack for connecting the AC monitor.

BP1 Binding Post - A tip connection for the LINE A jack.

BP2 Binding Post - A ring connection for the LINE A jack.

BP3 Binding Post - A tip connection for the LINE B jack.

BP4 Binding Post - A ring connection for the LINE B jack.

BP5 Pin Jack - A sleeve connection for the LINE B jack.

BP 6 Pin Jack - A sleeve connection for the LINE A jack.

BP7 Binding Post - A ground connection.

P1 Connector - A connection for external frequency determining networks.

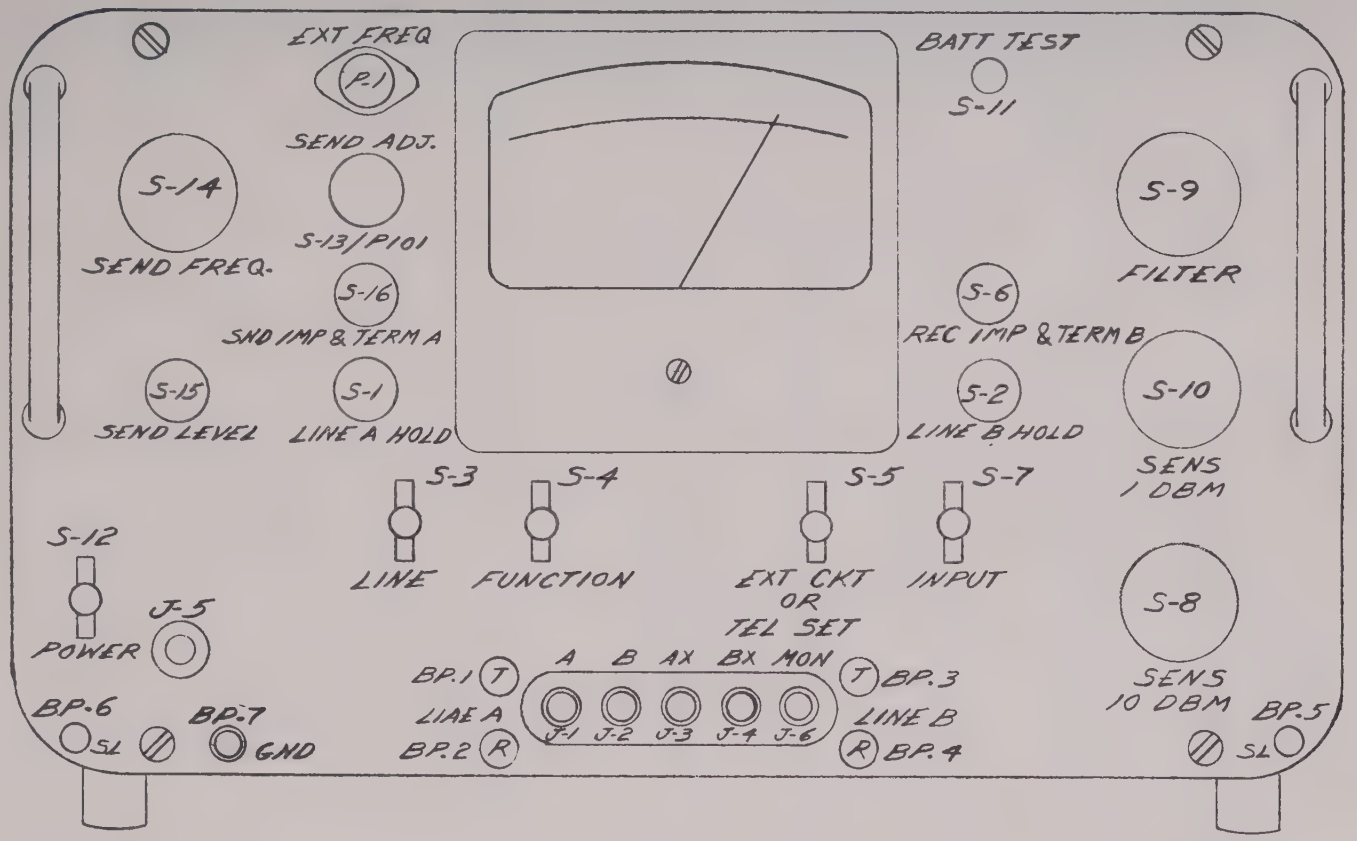

EXT FREQ
P-1
SEND ADJ.
S-13/P101
S-14
SEND FREQ.
S-16
SND IMP & TERM A
S-15
SEND LEVEL
S-1
LINE A HOLD
BATT TEST
S-11
S-9
FILTER
S-6
REC IMP & TERM B
S-2
LINE B HOLD
S-10
SENS 1 DBM
S-3
S-4
S-5
S-7
LINE
FUNCTION
EXT CKT OR TEL SET
INPUT
S-12
POWER
J-5
S-8
SENS 10 DBM
A B AX BX MON
BP.1
LIAE A
BP.2
J-1 J-2 J-3 J-4 J-6
BP.3
LINE B
BP.4
BP.6
SL
BP.7
GND
BP.5
SL

FIG. 2

5.0 CALIBRATION

5.01 No external calibration control is available. Normally no calibration is required, as the set is extremely stable and should hold its calibration for a long period of time. It may be desirable to make a routine check periodically to determine if there has been any change in calibration.

5.02 The calibration is checked by applying an extremely accurate 0 dbm 1000 cps signal to the receive section and setting both attenuators at 0 dbm. The meter should read 0 db. If it does not, the set should be recalibrated.

5.03 With the POWER switch in the OFF position, check the mechanical zero of the meter. If correction is needed, a small adjustment can be made to the mechanical zero screw on the face of the meter.

5.04 Check the condition of internal batteries, using BATT TEST push button. If meter does not read in green arc marked GOOD, replace batteries.

5.05 To calibrate the set remove the set from its case. Apply a 1 mw 1000 cps signal to the receiver and adjust R308, which is located on the amplifier board, until the meter reads 0 db.

Send Section

5.06 A front panel control is provided for calibration of the output level.

6.0 OPERATION

6.01 Preparation

1. Open lid. May be detached by moving lid to the right.
2. For use on internal batteries turn POWER switch to BATT position.
3. Depress BATT TEST push button and note if meter reads in green arc marked GOOD. Replace internal batteries if needle reads below green arc. Procedure for replacing batteries is given in paragraph 7.03.
4. For use with 48 volt central office battery ignore steps 2 and 3 and follow steps 5 through 10 below.
5. Insert cord in jack marked 48V on test set.
6. Connect cord to 48 volt central office battery. Tip BATT, sleeve GND. Caution. Do not reverse steps 5 and 6.
7. Turn POWER switch to 48V position.
8. Depress BATT TEST push button and observe an up scale reading on the meter.
9. If meter does not read up scale, reverse the connection to the 48 volt central office battery. Repeat step 8.
10. To disconnect the test set from the 48 volt central office battery, first turn the POWER switch to the OFF position. Next, remove the cord from the 48 volt central office battery. Finally, remove the cord from the test set. Caution: do not change the sequence of steps.
11. The unit is now ready for use.

6.02 To Calibrate Send Level

1. Complete steps under 6.01.
2. Set the SEND FREQ to 1000 cps.
3. Set the SEND LEVEL to 0.
4. Set the SEND IMP to the desired send impedance.
5. Set the INPUT to TERM.
6. Set the REC IMP to the same impedance as the SEND IMP.

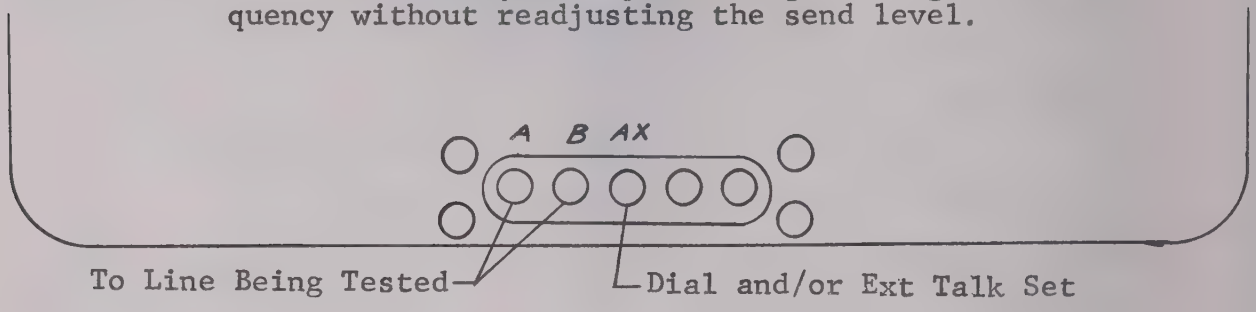
7. Set the SENS switches to the value of the desired SEND level.

8. Set the FILTER to 15 KC.

9. Set the FUNCTION to SND ADJ.

10. Adjust the SND ADJ for 0 db on the meter.

NOTE: The level variation when switching frequencies is less than .2 db, thus permitting a change of frequency without readjusting the send level.



6.03 To Dial and Hold Circuit

1. Operate LINE A HOLD switch to ON to hold circuit connected to LINE A jack and to OFF to release circuit.

2. Operate LINE B HOLD switch to ON to hold circuit connected to LINE B jack and to OFF to release circuit.

NOTE: The HOLD circuit when ON will hold a circuit connected to the LINE jack regardless of the position of any other switch.

3. Connect a dial or subscriber set with dial to the AX jack.

4. Turn LINE HOLD switch to OFF.

5. By placing the EXT CKT or TEL SET switch in the AX ON A or AX ON B position, a connection is established to the circuit connected to the LINE A or LINE B jack.

6. A number may now be dialed on the circuit connected to the LINE jack.

6.04 To Talk

1. Connect an external talk set to the AX jack.

2. By placing the EXT CKT or TEL SET in the AX ON A or AX ON B position, connection is established to the circuit connected to the LINE A or LINE B jack.

NOTE: Circuit under test must supply DC talk battery.

6.05 To Send Tone

1. Complete steps under 6.01 and 6.02.
2. Set the EXT CKT or TEL SET switch to MEAS A&B.
3. Set the FUNCTION switch to 2-wire.
4. Set the LINE switch to the proper position. This connects the output of the oscillator to the line.

6.06 To Measure Tone

1. Complete steps under 6.01.
2. Set the INPUT switch to either BRDG or TERM.
3. Set the REC IMP switch to the desired impedance.
4. Set the FILTER switch to the desired filter.
5. Set the LINE switch to the proper position.
6. Set the EXT CKT or TEL SET switch to connect the talk set to the proper line.
7. Request tone to be sent.
8. When the tone is heard in the talk set, operate the EXT CKT or TEL SET switch to MEAS A AND B position.
9. Set the SENS switches to obtain a convenient reading on the meter (between the -3 db and +3 db marks, if possible). The level is the algebraic sum of the SENS switches and the meter reading.

   Example:

SENS Switches	Meter Reading	Level
+10 (white)	+1 (black)	+11
+20 (white)	-2 (black)	+18
0 (white)	-1.4 (black)	-1.4
-16 (white)	+2.4 (black)	-13.6
-21 (white)	-.6 (black)	-21.6

10. To monitor the tone being measured, connect a telephone headset to the AC MON jack. (This output jack can be connected to a 600 ohm impedance receiving device with little effect on the meter reading.)

6.07 VU Measurements

As the dynamic characteristics of the meter are identical to a VU meter, the making of VU measurements follows the same steps described for the tone measurements in paragraph 6.06.

6.08 Noise Measurements

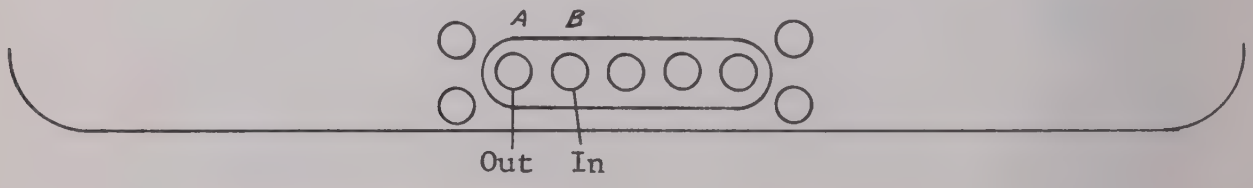
1. Follow steps 1 through 8 under paragraph 6.06.
2. Set the SENS switches to 85 (blue numbers).
3. Connect the circuit to be tested to the LINE jack.
4. Reset the SENS switches to obtain a convenient reading on the meter, preferably between 7 dbrn and 13 dbrn (blue numbers only).
5. The noise reading is then the algebraic sum of the SENS switches reading (blue numbers only), and the meter reading (blue numbers only).

Example

SENS Switches	Meter Reading	Noise Level
27 (blue)	7 (blue)	34 dbrn
35 (blue)	10 (blue)	45 dbrn
22 (blue)	12 (blue)	34 dbrn

NOTE 1: When recording noise measurements, the type of filter should be indicated, such as 42 dbrn-C-MSG or 85 dbrn 15 KC flat.

NOTE 2: To make noise to ground measurements, set input switch to N-GND and connect a good ground to the GND binding post.



6.09 Gain or Loss Measurements

1. Complete steps under 6.01, 6.02, 6.05, and 6.06 steps 2-8.

2. Connect the input and output of the equipment to be measured to the LINE A and B jacks.

3. Set the LINE switch for the proper position.

4. Set the SENS switches to obtain a convenient reading on the meter.

5. Gain or loss is the difference between the sending level and receiving level.

   Example:

Send Level	SENS Switches	Meter Reading	Gain (+) or Loss (-)
0	-5	-1.2	-6.2
0	+7	-.3	+6.7
-16	-16	+0.2	+0.2

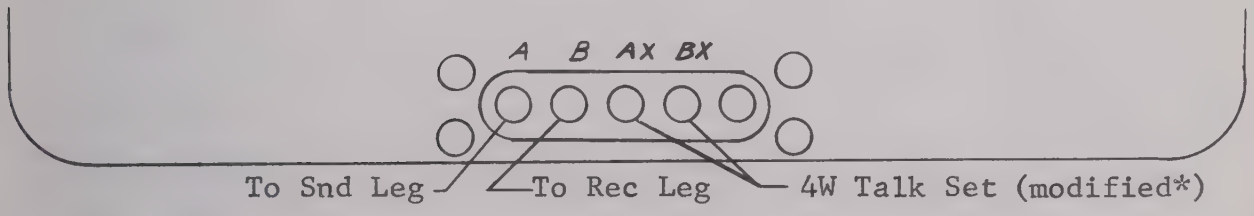
6.10 To Use Terminations

1. Set the EXT CKT or TEL SET switch to MEAS A&B.

2. Set the LINE switch to TERM A&B.

3. Select the desired termination by use of the SEND IMP switch for LINE A and the REC IMP switch for LINE B.

4. Connect the circuit to be terminated to either the LINE A or LINE B jack. The circuit under test is now terminated by either 600 or900 ohms +2 mfd.



6.11 4-Wire Circuits

1. Complete steps in paragraphs 6.01, 6.02, and 6.07.

2. Connect send leg of circuit under test to LINE A jack and receive leg to LINE B jack.

3. Set the FUNCTION switch to 4W.

4. Set the EXT CKT or TEL SET switch to MEAS A&B.

5. To send set the LINE switch to SND A.

6. To receive set the LINE switch to REC B.

6.12 Talk and Monitor on 4-Wire Circuits

*NOTE: A modification of a 52A type headset may be necessary to talk and monitor. The transmitter of the headset must be connected to the tip and ring of the AX jack. The receiver of the headset must be connected to the tip and ring of the BX jack.

1. Connect the send and receive legs of the circuit to be tested to the LINE A and LINE B jacks respectively.

2. Connect the transmitter and the receiver of the modified headset (see note above) to the AX and BX jacks respectively.

3. Set the EXT CKT or TEL SET key switch to the 4W AX ON A BX ON B position. This places the transmitter on the send leg and the receiver on the receive leg.

4. To monitor on the send leg reverse the headset plugs in AX and BX jacks, placing the receiver on the send leg.

6.13 Storage

Always attach the lid to the test set when not in use. This automatically turns the POWER switch to the OFF position when it is closed.

7.0 MAINTENANCE

7.01 Normally the set requires no maintenance other than checking its receive level calibration, as described in Section 5.0.

7.02 In the event of a grossly inaccurate or missing meter reading the following can be checked.

7.03 Batteries. This should always be checked first. This is conveniently done by turning the POWER switch to the BATT position, depressing the BATT TEST button, and observing a meter deflection within the green arc. To replace batteries, remove the screws holding the rear cover to the case. Remove retaining clips holding the batteries. Replace the batteries (1.5 volt D cells), observing polarity shown on battery holders. Recheck, using the BATT TEST push button. Deflection of the meter into the green arc indicates all is proper. Replace retaining clips and rear cover.

7.04 LINE, FUNCTION, EXT CKT or TEL SET switches to be in the proper positions.

7.05 SENS switch to be of sufficient sensitivity to give a reading.

7.06 INPUT to be connected to the proper jack or pair of terminals.

7.07 INPUT switch to be in the proper position.

7.08 FILTER switch set to allow the frequency of the input signal to pass.

7.09 Should all connections and settings be proper and no meter reading occurs, the circuitry can be checked. The following checks are made with a 1000 cps signal applied at 0 dbm level.

7.10 Input Circuit - Put SENS in -70 dbm position. Turn POWER to OFF. With either a VTVM or oscilloscope (CRO) trace the path of the signal. With the CRO grounded to the case, look at pin 7 of the transformer. The signal should be approximately 2 volts peak to peak. This should also appear at S10 on the wiper of the second deck from the chassis, and the wiper of the deck farthest from the chassis. The signal at S10 will be slightly less than at T1. The signal at S10 should also appear at the base of Q2. This is point R on the printed circuit board. (Figures 13 and 14 show the layouts of the two printed circuit boards with significant points indicated.)

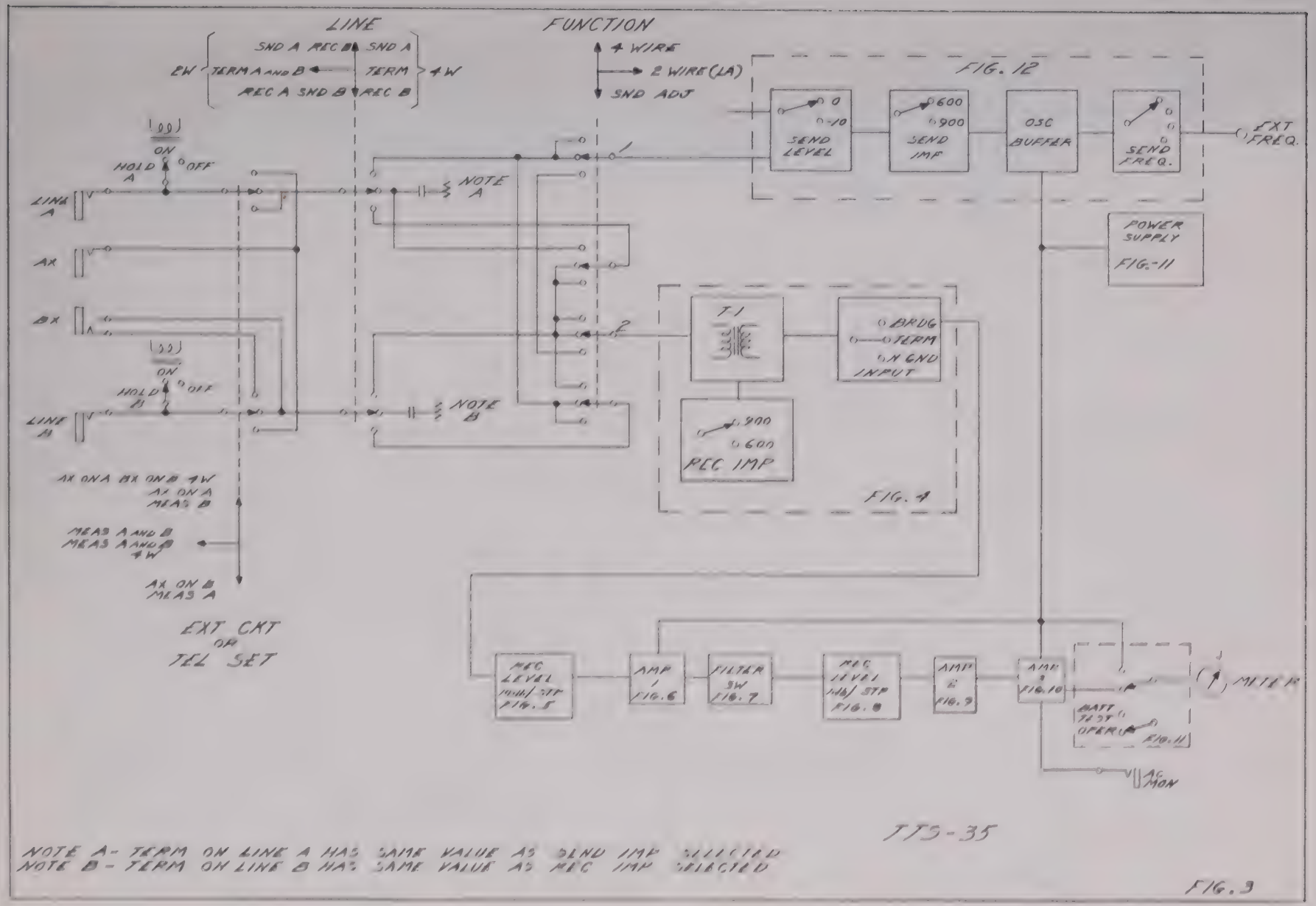
7.11 Amplifier 1 (Q102, Q103, Q104) - Set SENS to -40 dbm. The CRO should have a deflection sensitivity of at least 0.1 volt/cm. Place the CRO input at point 0. This is the output of Amplifier 1. The level here should be approximately 0.2 volts peak to peak. If it is, Amplifier 1 is satisfactory. If there is no output, or it is very low, proceed with the next step.

7.12 Amplifier 1 DC - Measure (20,000 ohms per volt -- no less than 10 volts full scale) the collector voltages of Q102 and Q103, as shown on the schematic. These DC voltages are for a fresh set of batteries.

7.13 Filter - If the signal appears normal at point 0, check point T. It should be approximately 0.06 volts peak to peak.

7.14 Amplifier 2 - If the signal is normal to point T, place SENS on 0 dbm and check the level at the collector of Q203. It should be approximately 0.15 volts peak to peak. If it is not, check the DC voltages of Amplifier 2 as shown on the schematic.

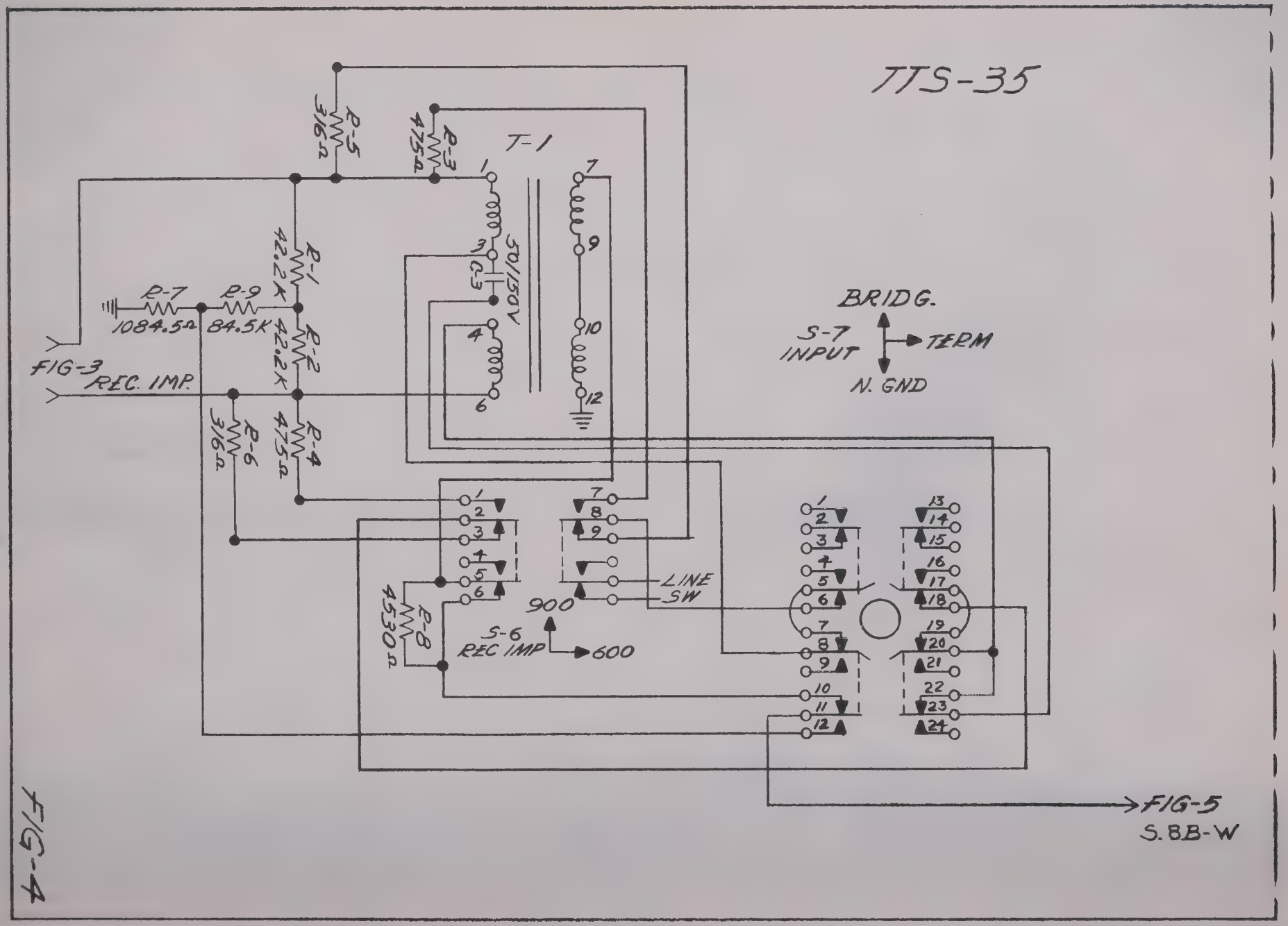
7.15 Amplifier 3 - If the point in step 7.14 is normal, check with the CRO the level at C304. This should be approximately 1.5 volts peak to peak and appear flattened. If it is not, check the DC voltages of Amplifier 3 as shown on the schematic.

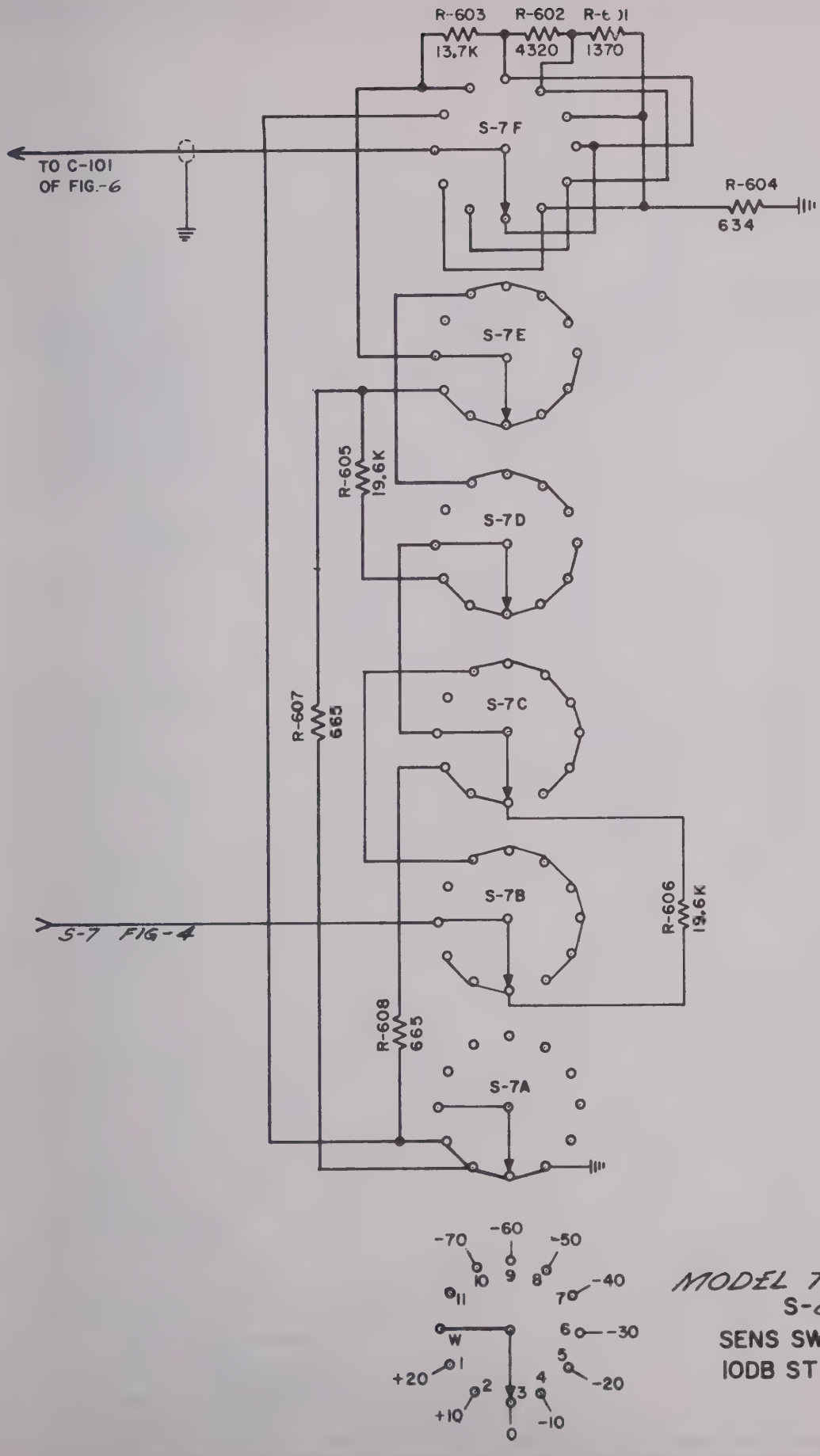


TTS-35

NOTE A- TERM ON LINE A HAS SAME VALUE AS SEND IMP SELECTED
NOTE B- TERM ON LINE B HAS SAME VALUE AS REC IMP SELECTED

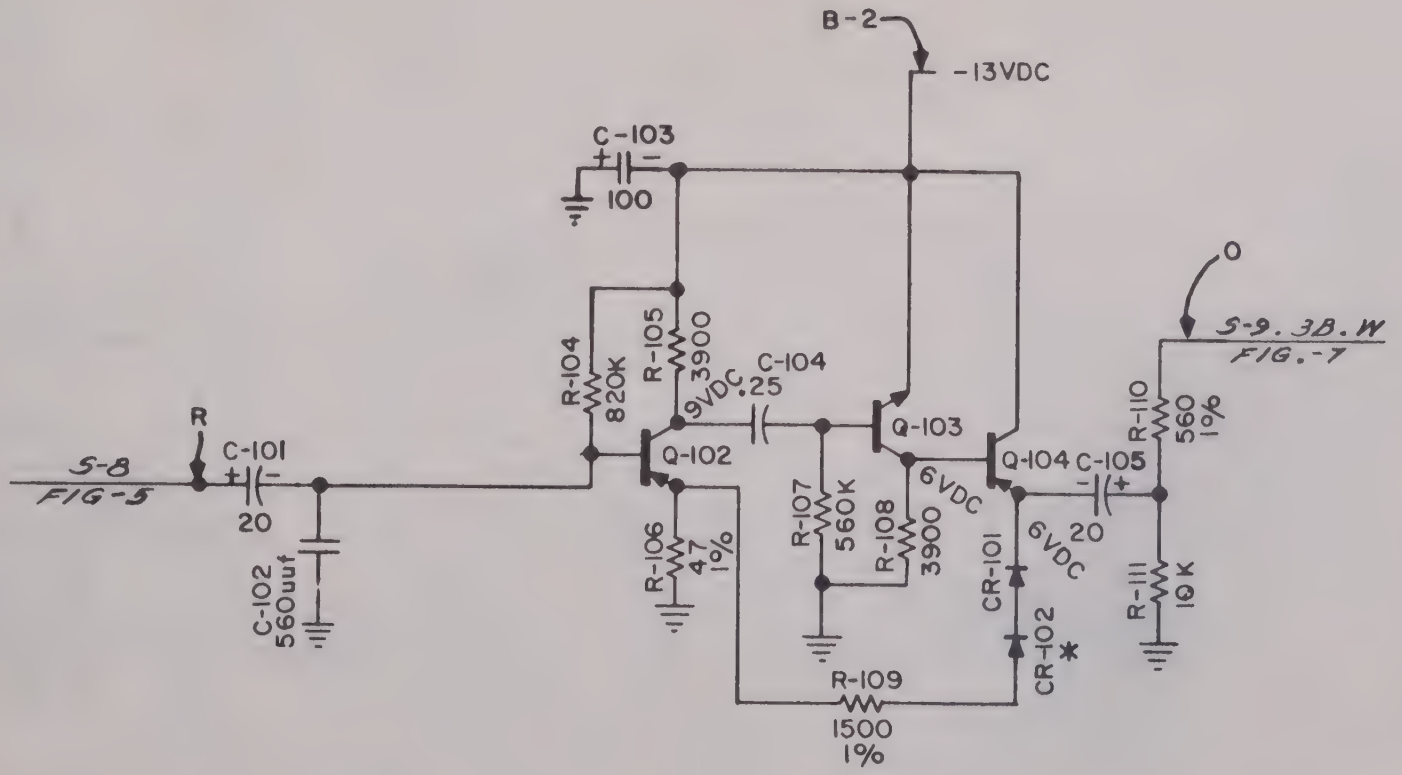
FIG. 3


TTS-35
T-1
R-5 316Ω
R-3 475Ω
R-1 42.2K
R-2 42.2K
R-7 1084.5Ω
R-9 84.5K
R-6 316Ω
R-4 475Ω
R-8 453Ω
C-3 .05/150V
FIG-3 REC. IMP.
BRIDG.
S-7 INPUT
TERM
N. GND
LINE SW
900
S-6 REC IMP
600
FIG-5
S.8B-W
FIG-4



MODEL TTS-35
S-8
SENS SWITCH
10DB STEPS

FIG.-5



ALL CAPACITORS IN uf
EXCEPT AS NOTED.
CR-101, CR-102 = 1N198
Q-102, Q-104 = 2N1374
Q-103 = 2N2102

* CR-102 MAY BE STRAPPED
IN SOME UNITS

MODEL TTS-35
ANN. #1

FIG-6

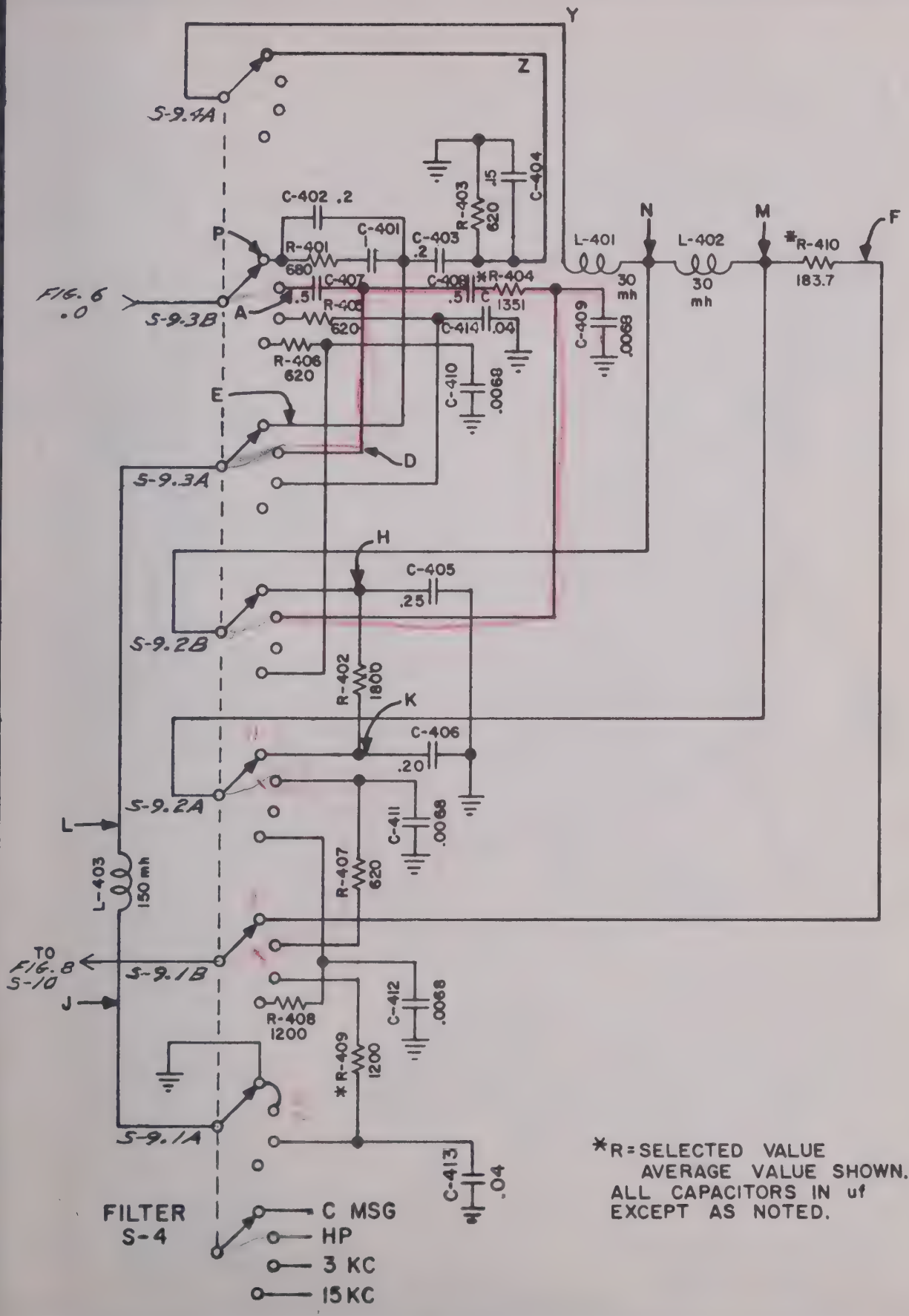
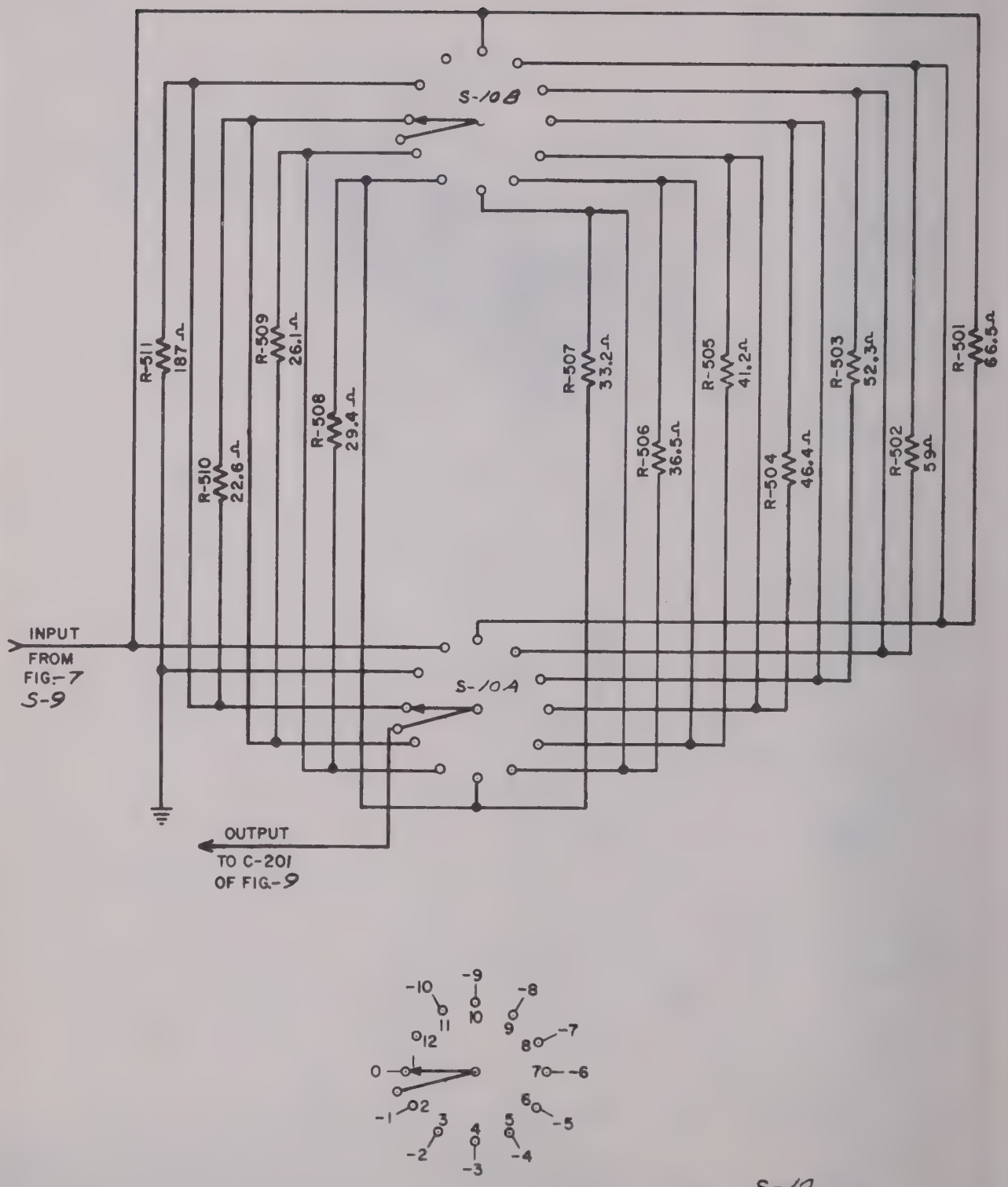
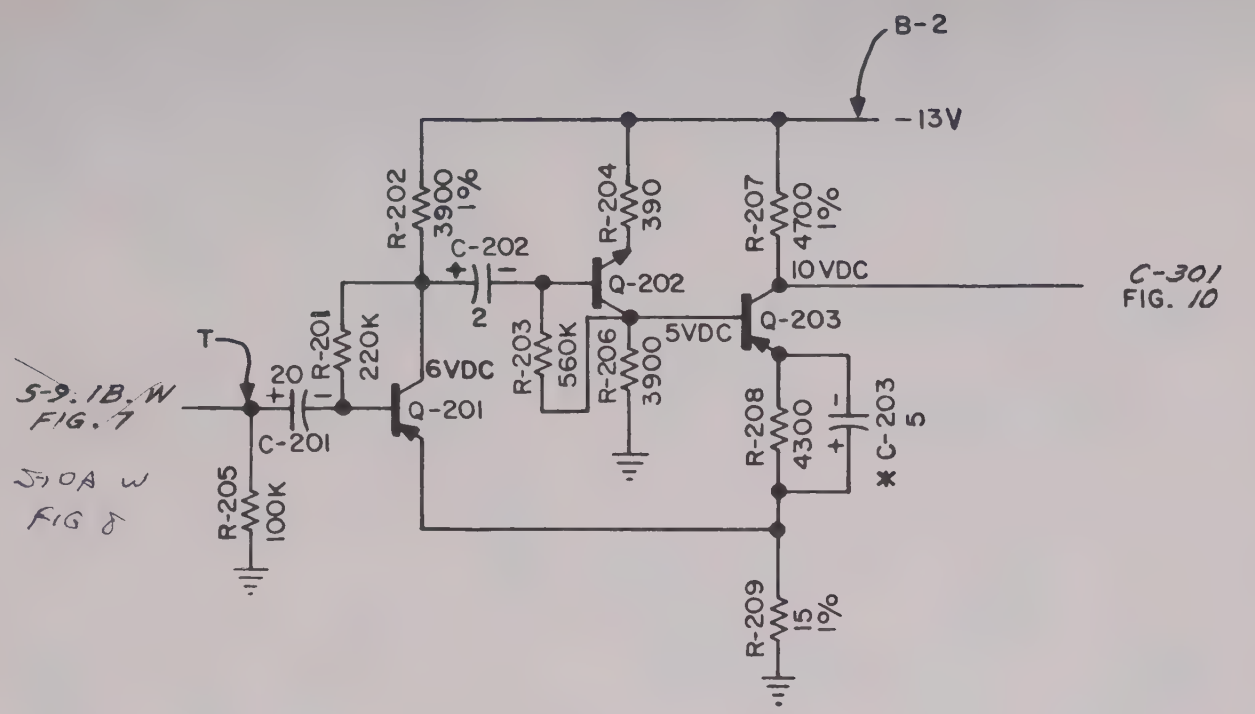

Y
Z
S-9.4A
C-402 .2
C-401
C-403 .2
R-403 620
J5
C-404
P
R-401 680
C-407 .5
R-402 620
R-406 620
A
FIG. 6 .0
S-9.3B
E
D
S-9.3A
C-408 .5
*R-404 C 1351
C-414 .04
C-410 .0068
C-409 .0068
L-401 30 mh
L-402 30 mh
N
M
F
*R-410 183.7
H
C-405 .25
S-9.2B
R-402 1800
K
C-406 .20
S-9.2A
C-411 .0068
L
L-403 150 mh
R-407 620
TO FIG. 8 S-10
S-9.1B
J
R-408 1200
C-412 .0068
*R-409 1200
S-9.1A
C-413 .04
FILTER S-4
C MSG
HP
3 KC
15 KC
*R = SELECTED VALUE
AVERAGE VALUE SHOWN.
ALL CAPACITORS IN uf
EXCEPT AS NOTED.

FIG. 7



S-10
SENS SWITCH
IDB STEPS

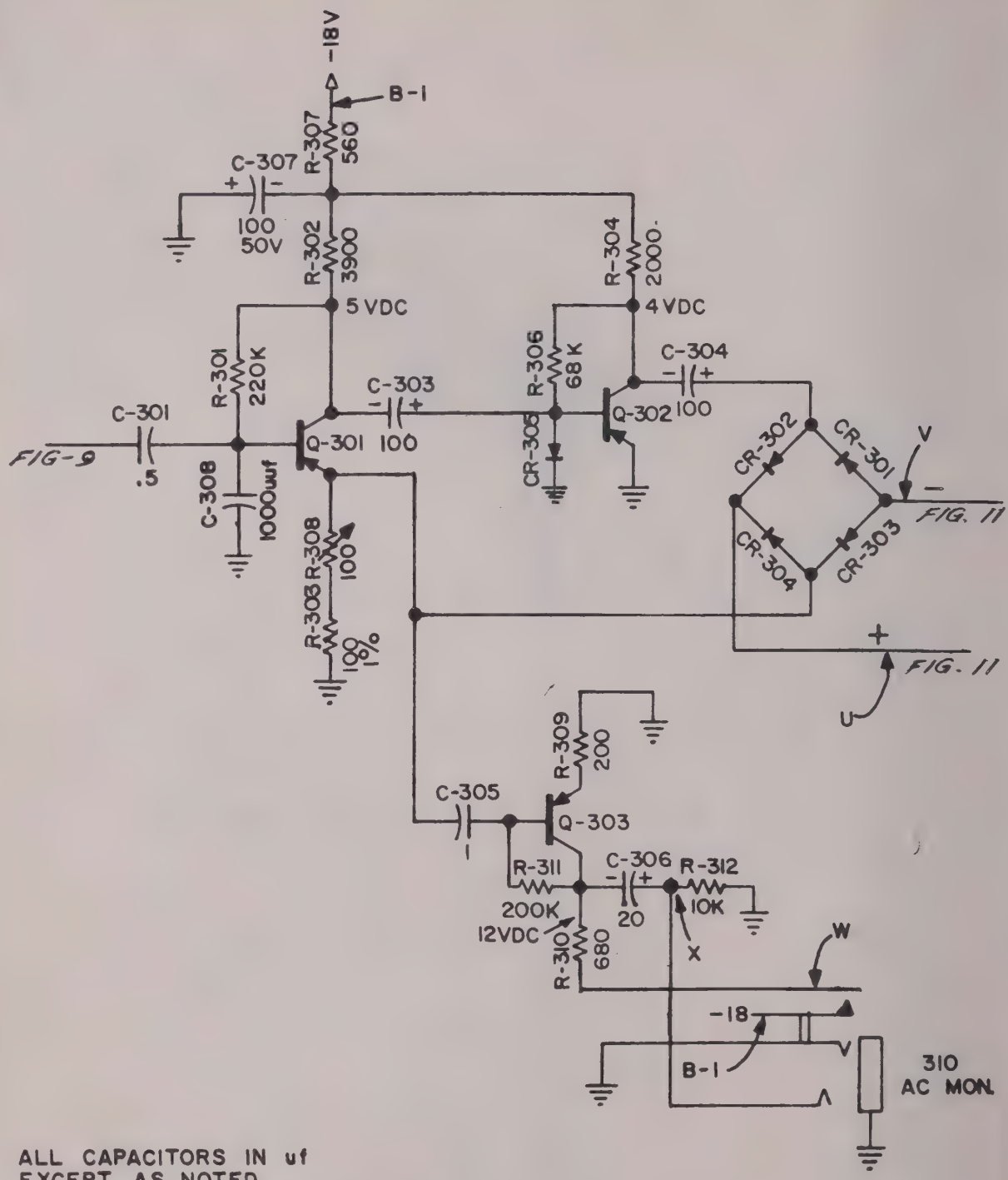
FIG.- 8



ALL CAPACITORS IN uf
EXCEPT AS NOTED
Q-201=2N1748A
Q-202=2N2102
Q-203=2N1374
* SELECTED VALUE, AVERAGE VALUE SHOWN

MODEL TTS-35
AMP #2

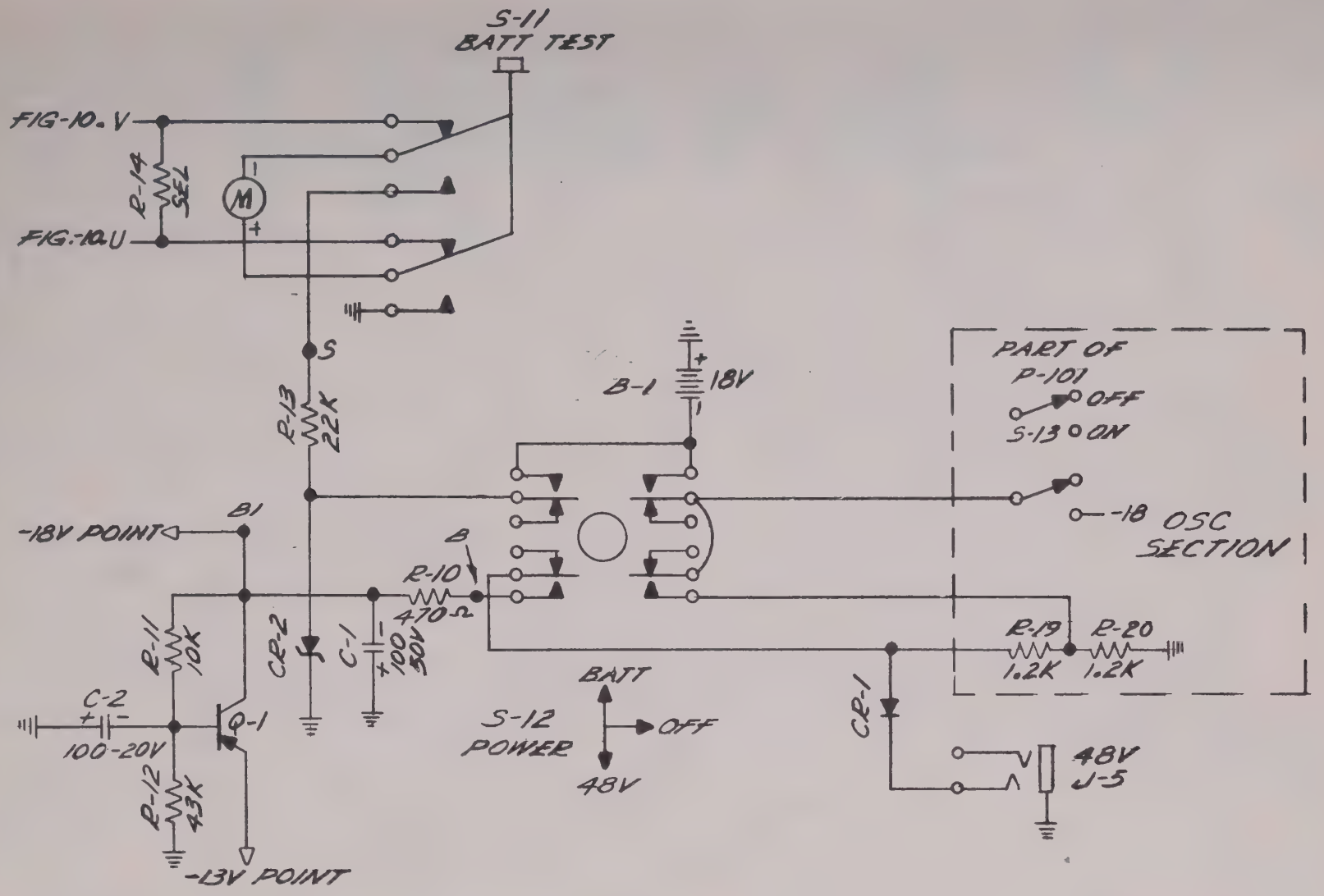
FIG. 9



ALL CAPACITORS IN uf
EXCEPT AS NOTED.
Q-301, Q-302, Q-303 = 2N1374
CR-301 THRU CR-305 = IN198

MODEL TTS-35
AMP #3

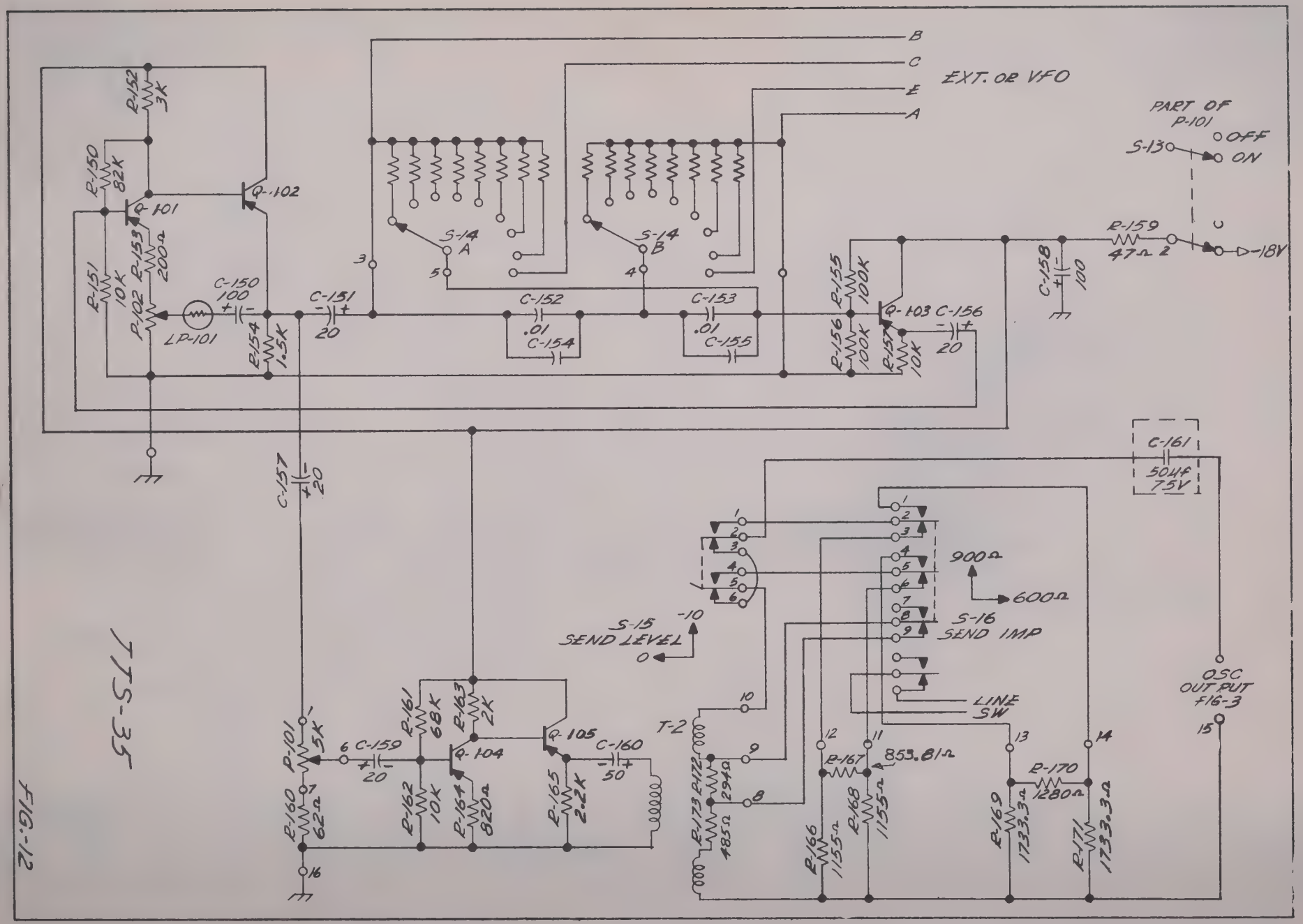
FIG. 10

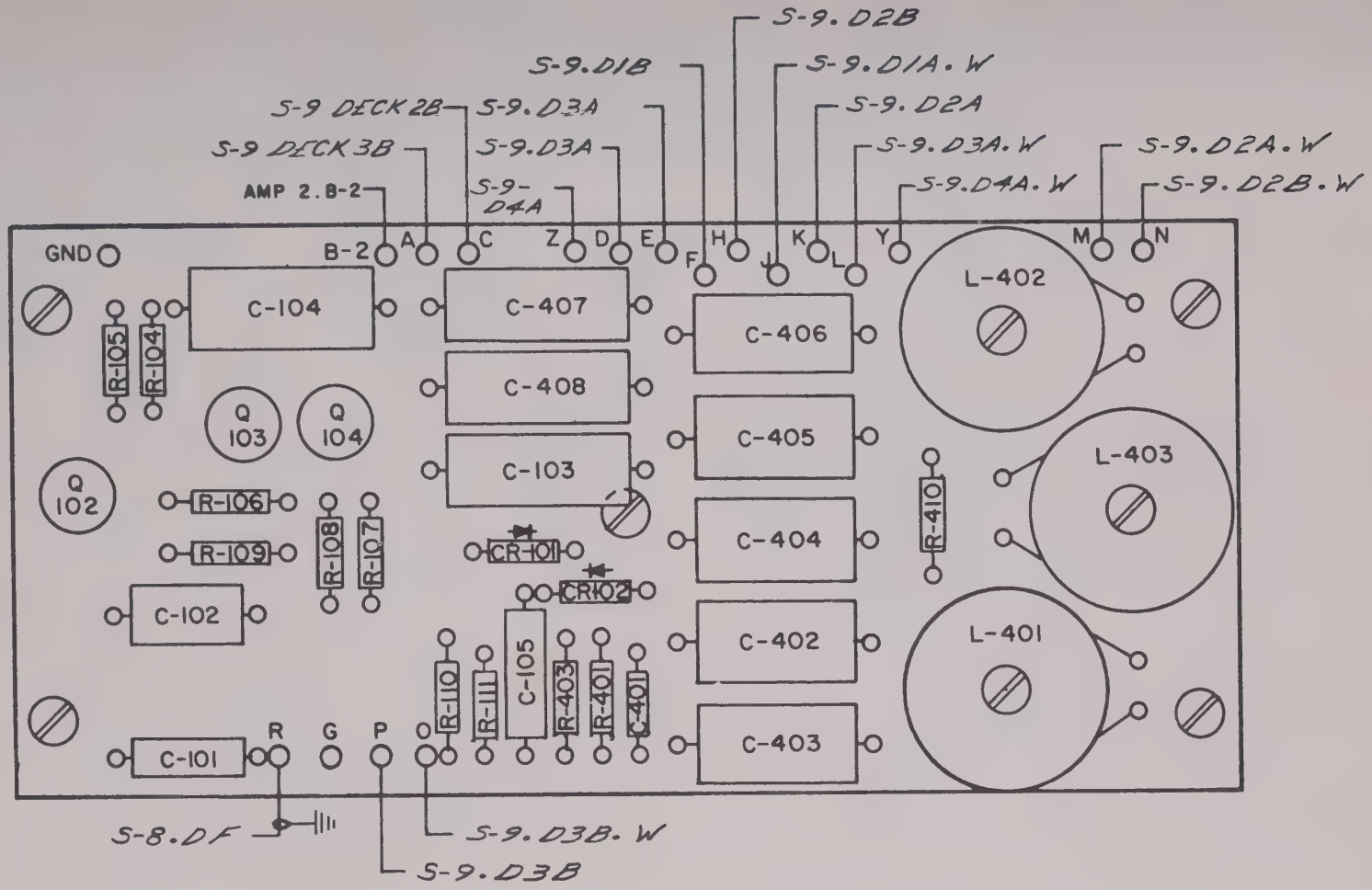


Q-1 = 2N1375
CR-1 = IN2069
CR-2 = IN3029B
R-1, R-2 + R-10 ARE 3W

MODEL TTS-35
POWER SCHEMATIC

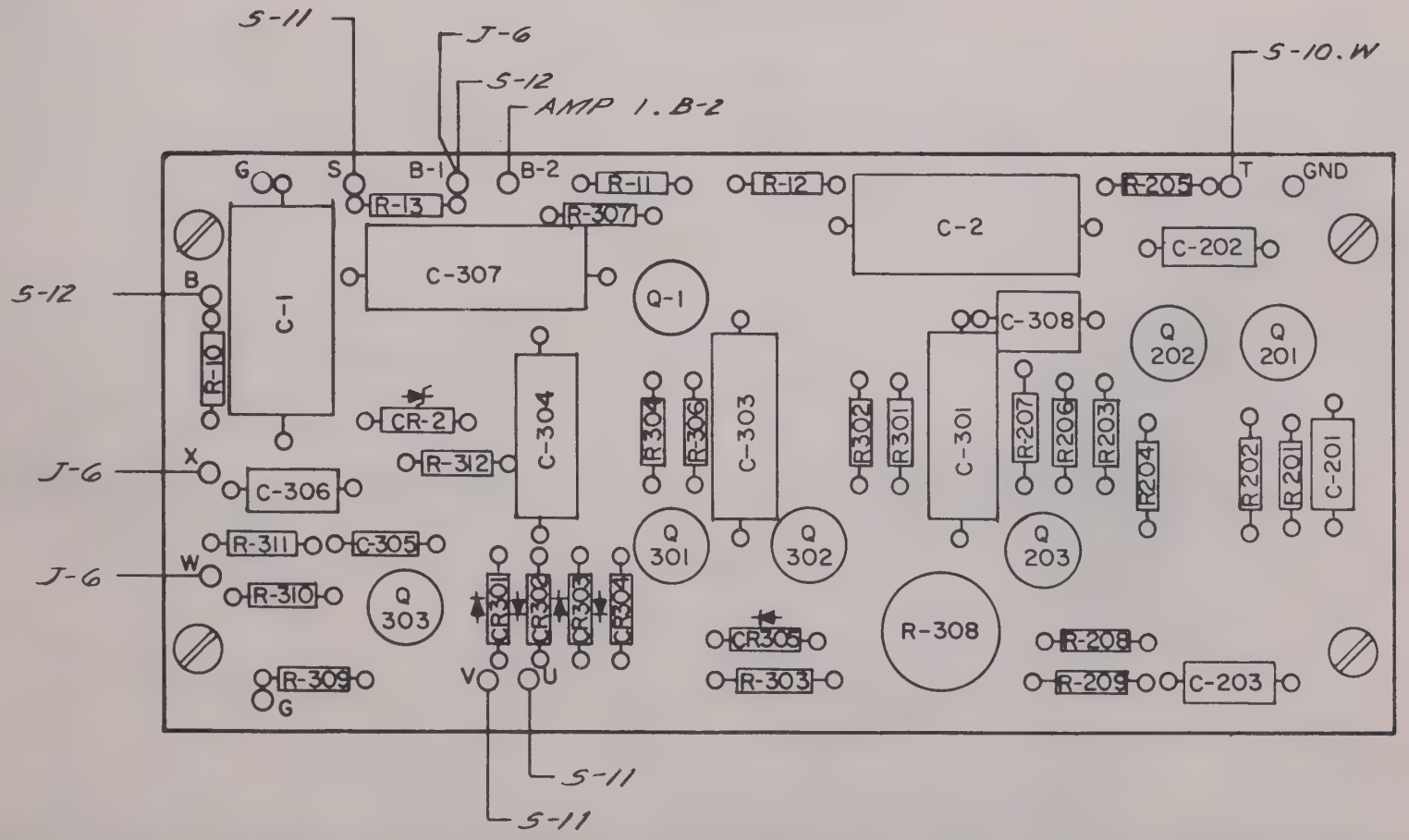
FIG-11


TTS-35
FIG. 12
B
C
E
A
EXT. OR VFO
PART OF P-101
S-13
OFF
ON
-18V
R-152 3K
R-150 82K
Q-101
Q-102
R-153 200Ω
R-151 10K
R-102
LP-101
C-150 100
C-151 20
R-154 1.5K
S-14 A
S-14 B
3
5
4
C-152 .01
C-154
C-153 .01
C-155
R-155 100K
Q-103
C-156 20
R-156 100K
R-157 10K
C-158 100
R-159 47Ω 2
C-157 20
C-161 50μf 75V
900Ω
600Ω
S-16 SEND IMP
S-15 SEND LEVEL
-10
0
LINE SW
OSC OUT PUT F16-3
T-2
R-101 5K
C-159 20
R-161 68K
R-163 2K
Q-104
Q-105
C-160 50
R-162 10K
R-164 820Ω
R-165 2.2K
R-160 62Ω
R-173 R-172 294Ω
485Ω
R-167 853.81Ω
R-168 1155Ω
R-166 1155Ω
R-169 1733.3Ω
R-170 1280Ω
R-171 1733.3Ω
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16



TTS-35
AMP #1
COMPONENT LOCATION

FIG. 13

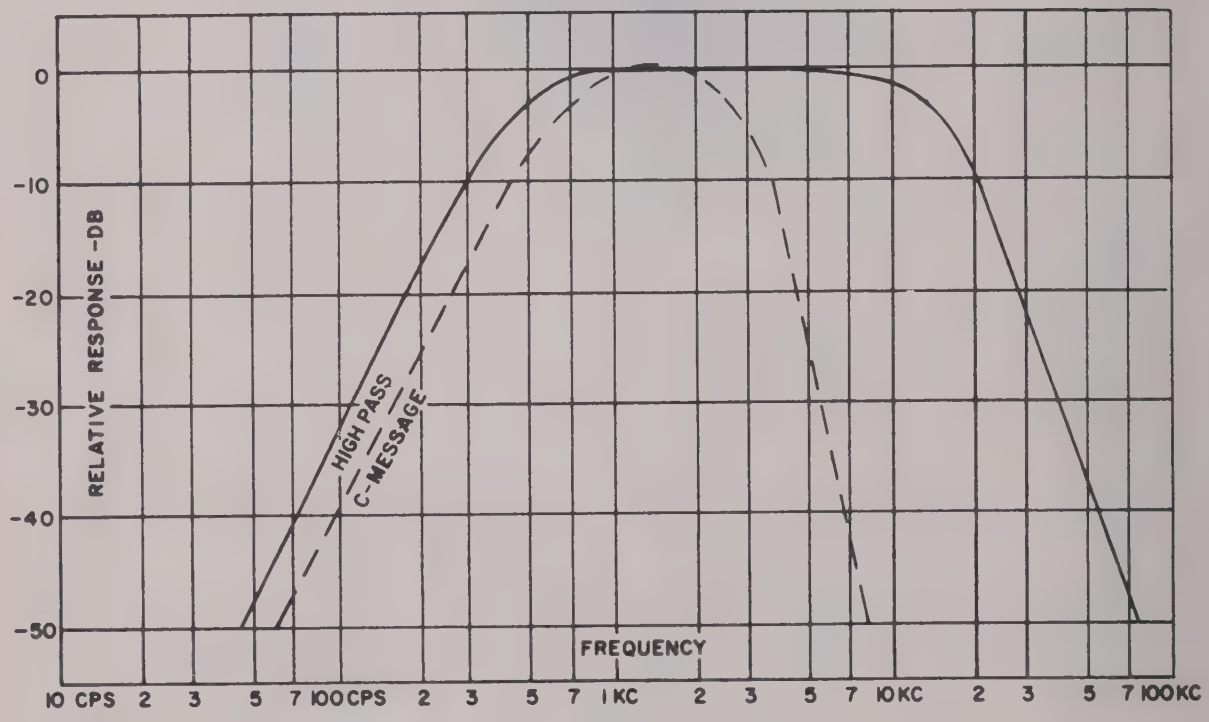


MODEL TTS-35
AMP #2
COMPONENT LOCATION

FIG. 14

MODEL TTS-35
OSC / BUFFER
ASSEMBLY

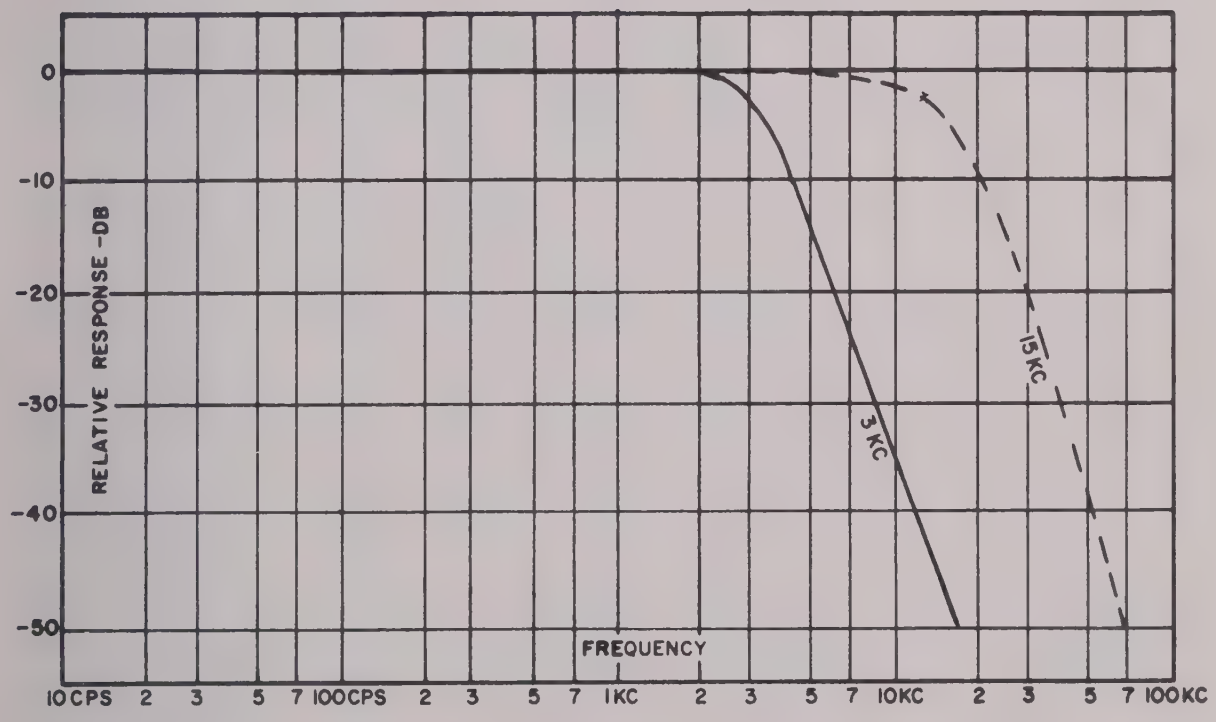
FIG-15



MODEL TTS-35

FREQUENCY RESPONSE
WITH
C-MESSAGE AND HIGH PASS FILTERS

FIG.-16



MODEL TTS-35

FREQUENCY RESPONSE
WITH
3 KC and 15 KC FILTERS

FIG.-17

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
C1	Capacitor: fixed, electrolytic, 100 mfd, 50 vdc	I, APD-127
C2	Capacitor: fixed, electrolytic, 100 mfd, 50 vdc	I, APD-127
C3A	Capacitor: fixed, electrolytic, 100 mfd, 150 vdc	R, TVA-1420
C3B	Capacitor: fixed, electrolytic, 100 mfd, 150 vdc	R, TVA-1420
C4	Capacitor: fixed, paper, 2.0 mfd, 150 vdc	R, 121P
C5	Capacitor: fixed, paper, 2.0 mfd, 150 vdc	R, 121P
C101	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C102	Capacitor: fixed, mica, 560 mmfd, 400 vdc	B, CM20D561
C103	Capacitor: fixed, electrolytic, 100 mfd, 20 vdc	I, APD-095
C104	Capacitor: fixed, paper, .25 mfd, 80 vdc	R, 192P
C105	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C150	Capacitor: fixed, electrolytic, 100 mfd, 20 vdc	I, APD-095
C151	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C152	Capacitor: fixed, paper, .01 mfd, 80 vdc	R, 192P
C153	Capacitor: fixed, paper, .01 mfd, 80 vdc	R, 192P
C154	Capacitor: fixed, selected value	
C155	Capacitor: fixed, selected value	
C156	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C157	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C158	Capacitor: fixed, electrolytic, 100 mfd, 20 vdc	I, APD-095
C159	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C160	Capacitor: fixed, electrolytic, 50 mfd, 15 vdc	I, APD-054
C161	Capacitor: fixed, NPO, 50 mfd, 75 vdc	R, D-27359
C201	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C202	Capacitor: fixed, electrolytic, 2 mfd, 15 vdc	R, TE1149
C203	Capacitor: fixed, electrolytic, 5 mfd, 15 vdc	R, TE1152
C301	Capacitor: fixed, paper, .5 mfd, 80 vdc	R, 192P
C303	Capacitor: fixed, electrolytic, 100 mfd, 20 vdc	I, APD-095
C304	Capacitor: fixed, electrolytic, 100 mfd, 20 vdc	I, APD-095
C305	Capacitor: fixed, disc, .1 mfd, 75 vdc	D, DDA-104
C306	Capacitor: fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C307	Capacitor: fixed, electrolytic, 100 mfd, 50 vdc	I, APD-127
C308	Capacitor: fixed, mica, 1000 mmfd, 400 vdc	B, CM19E102
C401	Capacitor: fixed, disc, 1 mfd, 25 vdc	R, 5C13
C402	Capacitor: fixed, paper, .2 mfd, 80 vdc	R, 192P
C403	Capacitor: fixed, paper, .2 mfd, 80 vdc	R, 192P
C404	Capacitor: fixed, paper, .15 mfd, 80 vdc	R, 192P
C405	Capacitor: fixed, paper, .25 mfd, 80 vdc	R, 192P
C406	Capacitor: fixed, paper, .2 mfd, 80 vdc	R, 192P
C407	Capacitor: fixed, paper, .5 mfd, 80 vdc	R, 192P
R408	Capacitor: fixed, paper, .5 mfd, 80 vdc	R, 192P
C409	Capacitor: fixed, paper, .0068 mfd, 80 vdc	R, 192P
C410	Capacitor: fixed, paper, .0068 mfd, 80 vdc	R, 192P
C411	Capacitor: fixed, paper, .0068 mfd, 80 vdc	R, 192P
C412	Capacitor: fixed, paper, .0068 mfd, 80 vdc	R, 192P
C413	Capacitor: fixed, paper, .04 mfd, 80 vdc	R, 192P
C414	Capacitor: fixed, paper, .04 mfd, 80 vdc	R, 192P

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
R1	Resistor: fixed, metal film, 42.2 K ±1%, ½ w	J, CEC-TO
R2	Resistor: fixed, metal film, 42.2 K ±1%, ½ w	J, CEC-TO
R3	Resistor: fixed, metal film, 475 ohms ±1%, ½ w	J, CEC-TO
R4	Resistor: fixed, metal film, 475 ohms ±1%, ½ w	J, CEC-TO
R5	Resistor: fixed, metal film, 316 ohms ±1%, ½ w	J, CEC-TO
R6	Resistor: fixed, metal film, 316 ohms ±1%, ½ w	J, CEC-TO
R7	Resistor: fixed, metal film, 1.0845 K ±1%, ½ w	J, CEC-TO
R8	Resistor: fixed, metal film, 4.530 K ±1%, ½ w	J, CEC-TO
R9	Resistor: fixed, metal film, 84.5 K ±1%, ½ w	J, CEC-TO
R10	Resistor: fixed, wirewound, 470 ohms ±5%, 3 w	R, 242E
R11	Resistor: fixed, composition, 10 K ±10%, ½ w	A, EB1031
R12	Resistor: fixed, composition, 43 K ±5%, ½ w	A, EB4335
R13	Resistor: fixed, metal film, 22 K ±1%, ½ w	J, CEC-TO
R14	Resistor: fixed, wirewound, selected value	V, CR16
R15	Resistor: fixed, wirewound, 600 ohms ±5%, 3 w	R, 242E
R16	Resistor: fixed, wirewound, 300 ohms ±5%, 3 w	R, 242E
R17	Resistor: fixed, wirewound, 300 ohms ±5%, 3 w	R, 242E
R18	Resistor: fixed, wirewound, 600 ohms ±5%, 3 w	R, 242E
R19	Resistor: fixed, wirewound, 1.2 K ±5%, 3 w	R, 242E
R20	Resistor: fixed, wirewound, 1.2 K ±5%, 3 w	R, 242E
R104	Resistor: fixed, composition, 820 K ±10%, ½ w	A, EB8241
R105	Resistor: fixed, composition, 3.9 K ±5%, ½ w	A, EB3925
R106	Resistor: fixed, metal film, 47 ohms ±1%, ½ w	J, CEC-TO
R107	Resistor: fixed, composition, 3.9 K ±5%, ½ w	A, EB3925
R108	Resistor: fixed, composition, 560 K ±10%, ½ w	A, EB5641
R109	Resistor: fixed, metal film, 1.5 K ±1%, ½ w	J, CEC-TO
R110	Resistor: fixed, metal film, 560 ohms ±1%, ½ w	J, CEC-TO
R111	Resistor: fixed, composition, 10 K ±10%, ½ w	A, EB1031
R150	Resistor: fixed, composition, 68 K ±10%, ½ w	A, EB6231
R151	Resistor: fixed, composition, 10 K ±5%, ½ w	A, EB1035
R152	Resistor: fixed, composition, 3 K ±5%, ½ w	A, EB3025
R153	Resistor: fixed, composition, 200 ohms ±5%, ½ w	A, EB2015
R154	Resistor: fixed, composition, 1.1 K ±5%, ½ w	A, EB1125
R155	Resistor: fixed, composition, 100 K ±10%, ½ w	A, EB1041
R156	Resistor: fixed, composition, 100 K ±10%, ½ w	A, EB1041
R157	Resistor: fixed, composition, 10 K ±5%, ½ w	A, EB1035
R158	Resistor: fixed, composition, 1.5 K ±5%, ½ w	A, EB1525
R159	Resistor: fixed, composition, 47 ohms ±5%, ½ w	A, EB4705
R160	Resistor: fixed, composition, 62 ohms ±5%, ½ w	A, EB6205
R161	Resistor: fixed, composition, 68 K ±5%, ½ w	A, EB6835
R162	Resistor: fixed, composition, 10 K ±10%, ½ w	A, EB1031
R163	Resistor: fixed, composition, 2 K ±5%, ½ w	A, EB2025
R164	Resistor: fixed, composition, 820 ohms ±10%, ½ w	A, EB8211
R165	Resistor: fixed, composition, 2.2 K ±5%, ½ w	A, EB2225
R166	Resistor: fixed, metal film, 1.155 K ±1%, ½ w	J, CEC-TO
R167	Resistor: fixed, metal film, 853.81 ohms ±1%, ½ w	J, CEC-TO
R168	Resistor: fixed, metal film, 1.155 K ±1%, ½ w	J, CEC-TO
R169	Resistor: fixed, metal film, 1.7337 K ±1%, ½ w	J, CEC-TO

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
R170	Resistor: fixed, metal film, 1.280 K ±1%, ½ w	J, CEC-TO
R171	Resistor: fixed, metal film, 1.7337 K ±1%, ½ w	J, CEC-TO
R172	Resistor: fixed, metal film, 294 ohms ±1%, ½ w	J, CEC-TO
R173	Resistor: fixed, metal film, 485 ohms ±1%, ½ w	J, CEC-TO
R201	Resistor: fixed, composition, 220 K ±10%, ½ w	A, EB2241
R202	Resistor: fixed, metal film, 3.9 K ±1%, ½ w	J, CEC-TO
R203	Resistor: fixed, composition, 560 K ±10%, ½ w	A, EB5641
R204	Resistor: fixed, composition, 390 ohms ±10%, ½ w	A, EB3911
R205	Resistor: fixed, composition, 100 K ±10%, ½ w	A, EB1041
R206	Resistor: fixed, composition, 3.9 K ±5%, ½ w	A, EB3925
R207	Resistor: fixed, metal film, 4.7 K ±1%, ½ w	J, CEC-TO
R208	Resistor: fixed, composition, 4.3 K ±5%, ½ w	A, EB4325
R209	Resistor: fixed, metal film, 15 ohms ±1%, ½ w	J, CEC-TO
R301	Resistor: fixed, composition, 220 K ±10%, ½ w	A, EB2241
E302	Resistor: fixed, composition, 3.9 K ±5%, ½ w	A, EB3925
R303	Resistor: fixed, metal film, 150 ohms ±1%, ½ w	J, CEC-TO
R304	Resistor: fixed, composition, 2 K ±5%, ½ w	A, EB2025
R306	Resistor: fixed, composition, 68 K ±5%, ½ w	A, EB6835
R307	Resistor: fixed, composition, 560 ohms ±10%, ½ w	A, EB5611
R308	Resistor: variable, wirewound, 100 ohms 2 w	M, 39-100
R309	Resistor: fixed, composition, 200 ohms ±5%, ½ w	A, EB2015
R310	Resistor: fixed, composition, 680 ohms ±5%, ½ w	A, EB6815
R311	Resistor: fixed, composition, 200 K ±5%, ½ w	A, EB2045
R312	Resistor: fixed, composition, 10 K ±10%, ½ w	A, EB1031
R401	Resistor: fixed, metal film, 680 ohms ±1%, ½ w	J, CEC-TO
R402	Resistor: fixed, metal film, 1.8 K ±1%, ½ w	J, CEC-TO
R403	Resistor: fixed, metal film, 620 ohms ±1%, ½ w	J, CEC-TO
R404	Resistor: fixed, metal film, 1.351 K ±1%, ½ w	J, CEC-TO
R405	Resistor: fixed, metal film, 620 ohms ±1%, ½ w	J, CEC-TO
R406	Resistor: fixed, metal film, 620 ohms ±1%, ½ w	J, CEC-TO
R407	Resistor: fixed, metal film, 620 ohms ±1%, ½ w	J, CEC-TO
R408	Resistor: fixed, metal film, 1.2 K ±1%, ½ w	J, CEC-TO
R409	Resistor: fixed, metal film, 1.2 K ±1%, ½ w	J, CEC-TO
R410	Resistor: fixed, metal film, 183.7 ohms ±1%, ½ w	J, CEC-TO
R501	Resistor: fixed, metal film, 66.5 ohms ±1%, ½ w	J, CEC-TO
R502	Resistor: fixed, metal film, 59 ohms ±1%, ½ w	J, CEC-TO
R503	Resistor: fixed, metal film, 52.3 ohms ±1%, ½ w	J, CEC-TO
R504	Resistor: fixed, metal film, 46.4 ohms ±1%, ½ w	J, CEC-TO
R505	Resistor: fixed, metal film, 41.2 ohms ±1%, ½ w	J, CEC-TO
R506	Resistor: fixed, metal film, 36.5 ohms ±1%, ½ w	J, CEC-TO
R507	Resistor: fixed, metal film, 33.2 ohms ±1%, ½ w	J, CEC-TO
R508	Resistor: fixed, metal film, 29.4 ohms ±1%, ½ w	J, CEC-TO
R509	Resistor: fixed, metal film, 26.1 ohms ±1%, ½ w	J, CEC-TO
R510	Resistor: fixed, metal film, 22.6 ohms ±1%, ½ w	J, CEC-TO
R511	Resistor: fixed, metal film, 187 ohms ±1%, ½ w	J, CEC-TO
R601	Resistor: fixed, metal film, 1.37 K ±1%, ½ w	J, CEC-TO
R602	Resistor: fixed, metal film, 4.32 K ±1%, ½ w	J, CEC-TO
R603	Resistor: fixed, metal film, 13.7 K ±1%, ½ w	J, CEC-TO

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
R604	Resistor: fixed, metal film, 634 ohms ±1%, ½ w	J, CEC-TO
R605	Resistor: fixed, metal film, 19.6 K ±1%, ½ w	J, CEC-TO
R606	Resistor: fixed, metal film, 19.6 K ±1%, ½ w	J, CEC-TO
R607	Resistor: fixed, metal film, 665 ohms ±1%, ½ w	J, CEC-TO
R608	Resistor: fixed, metal film, 665 ohms ±1%, ½ w	J, CEC-TO
CR1	Diode	U, 1N2069
CR2	Diode: zener, 24 volts	L, 1N3029B
CR101	Diode: rectifier	U, 1N198
CR102	Diode: rectifier	U, 1N198
CR301	Diode: rectifier	U, 1N198
CR302	Diode: rectifier	U, 1N198
CR303	Diode: rectifier	U, 1N198
CR304	Diode: rectifier	U, 1N198
CR305	Diode: rectifier	U, 1N198
J1	Jack: telephone (LINE A)	T, 5J1329
J2	Jack: telephone (LINE B)	T, 5J1329
J3	Jack: telephone (AX)	T, 5J1329
J4	Jack: telephone (BX)	T, 5J1192
J5	Jack: 310 type (48 volt)	T, L12B
J6	Jack: telephone (AC MON)	T, 5J1191
L1	Inductor	N, TN1274
L2	Inductor	N, TN1274
L401	Inductor: 30 mh	X, EC-030
L402	Inductor: 30 mh	X, EC-030
L403	Inductor: 150 mh	X, ET-150
S1	Switch: turn button	T, 112062
S2	Switch: turn button	T, 112062
S3	Switch: key	S, 173P
S4	Switch: key	S, 173P
S5	Switch: key	S, 173P
S6	Switch: turn button	T, 11212L
S7	Switch: key	S, 173P
S8	Switch: rotary, 6 pole, 10 position	D, PA022-3329
S9	Switch: rotary, 8 pole, 4 position	D, PA022-3295
S10	Switch: rotary, 2 pole, 11 position	D, PA024-6277
S11	Switch: push button, DPDT	G, 46-200R
S12	Switch: key	T, 173N
S13	Switch: SPST (part of P101)	E, 35637NP
S14	Switch: rotary, 4 pole, 8 position	D, PA022-2528
S15	Switch: turn button	T, 11209L
S16	Switch: turn button	T, 11212L
T1	Transformer	Y, A20
T2	Transformer	Y, S015P
	Knobs: for S8, S9, S10, S14	C, SS70BLS-2
LP101	Lamp: resistance	H, T-4½
M1	Meter: special, 1 ma	N, 2121
P1	Receptacle	T, 61GASF

TABLE OF REPLACEABLE PARTS

Circuit Ref	Description	Mfr* & Mfr's Designation
P101	Potentiometer: switch, 5K, SPST	E, 35637NP
P102	Resistor: variable, 400 ohms	K, MTC-4
Q1	Transistor: PNP	W, 2N1375
Q102	Transistor: PNP	W, 2N1374
Q103	Transistor: NPN	O, 2N2102
Q104	Transistor: PNP	W, 2N1374
Q201	Transistor: PNP	R, 2N1748A
Q202	Transistor: NPN	O, 2N2102
Q203	Transistor: PNP	W, 2N1374
Q301	Transistor: PNP	W, 2N1374
Q302	Transistor: PNP	W, 2N1374
Q303	Transistor: PNP	W, 2N1374
Q101	Transistor: PNP, (OSC)	W, 2N1375
Q102	Transistor: PNP, (OSC)	W, 2N1375
Q103	Transistor: PNP, (OSC)	W, 2N1375
Q104	Transistor: PNP, (OSC)	W, 2N1375
Q105	Transistor: PNP, (OSC)	W, 2N1375
B1	Battery: D Cell, 1.5 volts (8 per set)	F, 950
BP1	Binding Post: red	G, 29-1R
BP2	Binding Post: black	G, 29-1B
BP3	Binding Post: red	G, 29-1R
BP4	Binding Post: black	G, 29-1B
BP5	Pin Jack	P, TJ-105BL
BP6	Pin Jack	P, TJ-105BL
BP7	Binding Post	Q, 137SP

*See List of Manufacturers Code Letters for Replaceable Parts Table

LIST OF MANUFACTURERS CODE LETTERS

Code Letter	Manufacturer
A	Allen-Bradley Company
B	ARCO Electronics, Inc.
C	Buckeye Robbin Company
D	Centralab
E	Clarostat Manufacturing Company
F	Eveready
G	Grayhill, Inc.
H	Herzog Miniature Lamp Works, Inc.
I	International Electronic Instruments
J	IRC, Inc.
K	Mallory Controls Company
L	Motorola Semiconductor Products, Inc.
M	The Muter Company
N	Northeast Electronics Corporation
O	Radio Corporation of America
P	Raytheon Company
Q	H. H. Smith Company
R	Sprague Electric Company
S	Stromberg-Carlson
T	Switchcraft, Inc.
U	Sylvania Electric Products
V	Tel-Labs, Inc.
W	Texas Instruments
X	Triad Distributor
Y	United Transformer Corporation

APPENDIX

MODEL TTS 35XV VARIABLE FREQUENCY COVER

1.0 GENERAL

1.01 The Model TTS 35XV Accessory cover contains an external frequency determining network for the oscillator in the TTS 35B Transmission Test Set. It provides a continuously variable frequency coverage from 200 cps to 7000 cps in three ranges.

1.02 The TTS 35XV should be used only with the unit to which it is attached when purchased. If it is used with any other set, the frequency calibration will not apply.

1.03 The TTS 35B is housed in a detachable cover 14" w x 8" h x 4½" d. Its weight is 3½ pounds.

2.0 TRANSMISSION PERFORMANCE

2.01 The frequency range of 200 cps to 7000 cps is covered in three ranges selected by a three position range selector switch:

200 - 700 cps
600 - 2100 cps
2000 - 7000 cps

A continuously variable adjustment controls the frequency in each range.

2.02 The output level of the oscillator is constant within ±0.30 db with frequency and the frequency accuracy is within 3% when used with the basic unit with which it has been calibrated.

2.03 The circuit diagram of the variable frequency network is shown in Figure 18.

3.0 OPERATION

3.01 Plug the connector at the end of the cable in the cover into the connector on the TTS 35B.

3.02 Turn the SEND FREQ switch to the EXT FREQ position.

3.03 Set the RANGE switch on the VFO to the B position and set the continuous tuning control to 1.0 (1 KC) on Scale B.

3.04 Adjust the SEND ADJ control on the TTS 35B with the FUNCTION switch in the SEND ADJ position to the desired output level.

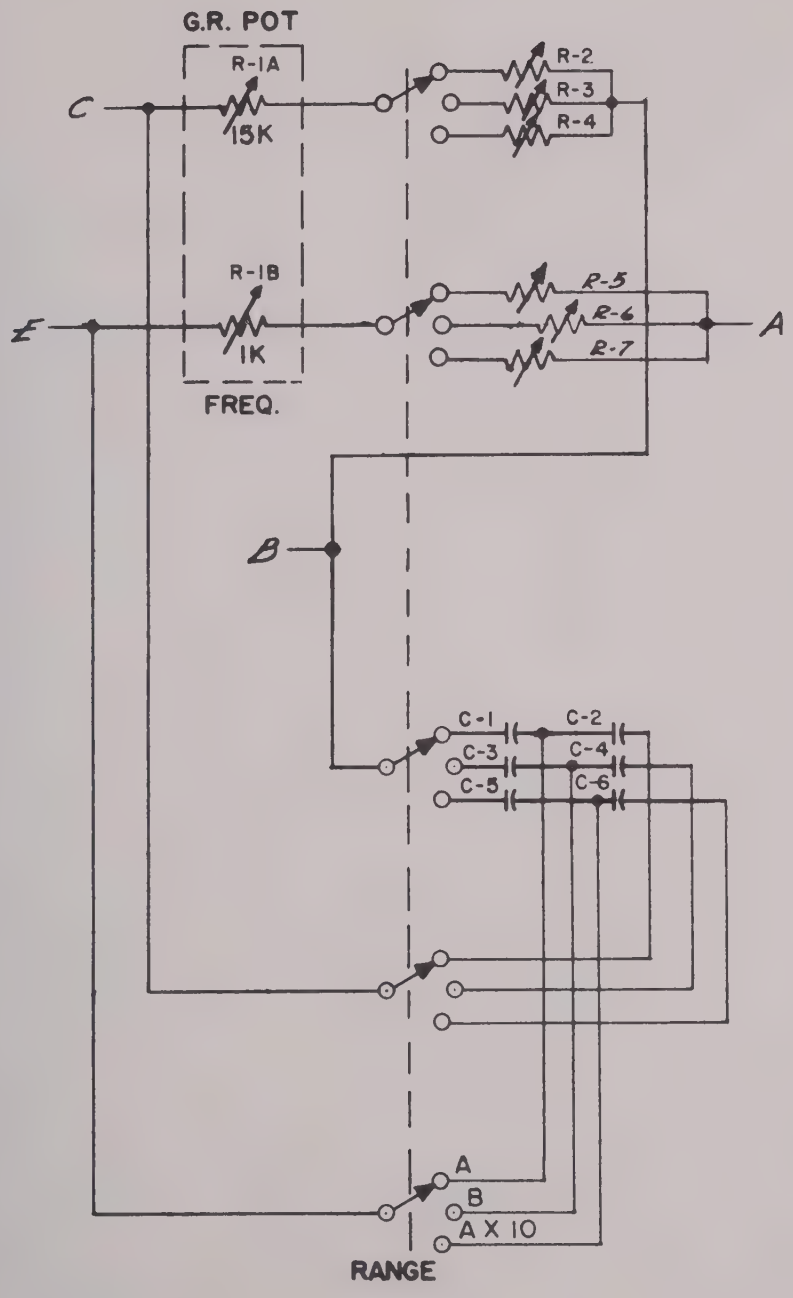
CAUTION: The setting of the SEND ADJ control to obtain a 0 dbm output with the VFO may differ by about 0.5 db from the adjustment required for the fixed frequencies. When transferring from fixed frequency operation to variable frequency operation, the output level must be recalibrated.

3.05 Follow the procedure for sending tone in the basic unit. The set is now ready to send signals at any desired frequency setting of the TTS 35XV tuning control.

4.0 MAINTENANCE

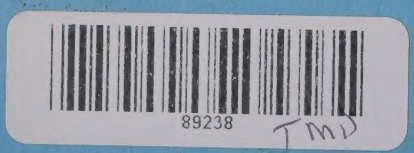
4.01 The Model TTX 35XV does not require routine maintenance.

4.02 In view of the critical adjustments which must be made to calibrate the set, it is recommended that the accessory cover be returned to the factory for repairs, together with the basic unit with which it is to be used.



MODEL TTS-35
VFO

FIG.-18


89238
TMJ